

BT 0077
Multimedia Systems

Contents

Unit 1	
Introduction to Multimedia	1
Unit 2	
Concepts of Drawings	41
Unit 3	
Concepts of Colours	71
Unit 4	
Typography	92
Unit 5	
Laws of Design	118
Unit 6	
Resolution	127
Unit 7	
Graphic Image files formats	152
Acknowledgements, References and Suggested Readings	164

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SUBJECT INTRODUCTION

Today multimedia might be defined as the seamless digital integration of text, graphics, animation, audio, still images and motion video in a way that provides individual users with high levels of control and interaction. The evolution of Multimedia is a story of the emergence and convergence of these technologies. Similarly graphics has been the major beneficiary of technological and creative changes and demands. Its no wonder that all elements in multimedia starts with at least a connotation to graphics if not the entire foundation. With the evolution of the application involving graphics, new dimension have been added to graphics and its imperative for anyone undergoing a study in graphics does justice to the subject.

This SLM on “Multimedia Systems” is divided into six units, the brief account of them is given below:

Unit 1: Introduction to Multimedia:

This unit gives an overview of various concepts of Multimedia. You will also learn about Multimedia elements, Digital Media, Interactivity and Application.

Unit 2: Concepts of Drawings:

In this unit, you will learn various drawing concepts, elements of drawing, drawing creating, types of drawings, drawing composition and diagrams.

Unit 3: Concepts of Colours

In this Unit, you will learn about various colour concepts, Characteristics of colour, colour wheel, Primary colours, Secondary colours, complementary colour, cool colours and colour modes and models.

Unit 4: Typography

This unit explains History of typography, Ancient writing system, World of typography, Typefaces and fonts, Tracking and kerning, Font family, True type fonts, Bitmapped and outline fonts and flow of typography.

Unit 5: Laws of Design

In this Unit, you will learn about laws of design, Balance, Rhythm, Emphasis, Unity, simplicity and Proportion and Symmetrical Balance, Inverted Symmetry, Biaxial Symmetry and Radial Symmetry.

Unit 6: Resolution

This unit explains concepts of resolution, Image resolution, Pixel dimension, Image classification, Monitor resolution, Printer resolution, and Screen frequency. Also it deals with file size, interpolated resolution, Graphic file formats.

Unit 7: Graphic Image files formats

In this Unit, you will learn various graphic file formats, file conversion and file compression techniques.

After studying this subject, you should be able to develop professional Interactive websites using HTML, DHTML, XML features. The subject requires knowledge and understanding of skills related to Internet, ISP, DNS servers and HTML.

Objective of studying the subject

After studying this subject, you should be able to Describe various concepts of Multimedia, Elements of drawing, concepts of Colour, Typeface and Fonts, Laws of design and Image and pixel resolution.

The subject requires knowledge and understanding of skills related to computer fundamentals.



For various multimedia and other resources on the subject, log on to TeL portal of SMU DDE at www.smude.edu.in.

Manipal

Unit 1

Introduction to Multimedia

Structure

- 1.0 Introduction to Multimedia & Objectives
- 1.1 History of Multimedia
- 1.2 Multimedia Elements
- 1.3 Digital Multimedia
- 1.4 Analog and Digital conversion
- 1.5 Digital media challenges
- 1.6 CD-ROM Delivers
- 1.7 CD-ROM Data Storage
- 1.8 Data Encoding and Reading
- 1.9 Interactivity
 - 1.9.1 Elements of interactivity
 - 1.9.2 Creating Interactive material:
 - 1.9.3 Using Interactivity Appropriately
- 1.10 Internet Vs Multimedia Vs entertainment
- 1.11 Multimedia Applications
- 1.12 Use of Multimedia in the Classroom
- 1.13 Multimedia Application: Design Training, Entertainment
- 1.14 Hypertext /Hypermedia
- 1.15 Hotspots
- 1.16 Digital Encyclopedia
- 1.17 Browsing the World of information
- 1.18 Multimedia Atlases
- 1.19 Control the World
- 1.20 Multimedia Future and Emerging Technologies
- 1.21 Social Software
- 1.22 Summary
- 1.23 Terminal Questions
- 1.24 Answers

1.0 Introduction to Multimedia

'Multimedia' evidently means 'The processing and presentation of information in two or more media', so computers which are capable of handling text and simple graphics, available for many years, could be called

'multimedia computers'. However, so many extra attributes have been developed that the word now usually means the processing and presentation of at least text, graphics, and pictures, if not animation and motion video, usually in colour with sound. There are many systems and activities within multimedia's fuzzy-edged border including hypertext, image processing, compression systems, colour electronics, input technologies like scanners, cameras, and picture frame grabbers, output technologies such as displays and reprography, transmission systems, Virtual Reality, and visualization. Compact Disk media and techniques, electronic books and journals, and videoconferencing are multimedia, as are computer games and home shopping.



Figure 1.1: Multimedia

Multimedia is more than one concurrent presentation medium (for example, on CD-ROM or a Web site). Although still images are a different medium than text, multimedia is typically used to mean the combination of text, sound, and/or motion video. Some people might say that the addition of animated images (for example, animated GIF on the Web) produces multimedia, but it has typically meant one of the following:

- Text and sound
- Text, sound, and still or animated graphic images
- Text, sound, and video images
- Video and sound
- Multiple display areas, images, or presentations presented concurrently
- In live situations, the use of a speaker or actors and "props" together with sound, images, and motion video

Multimedia can arguably be distinguished from traditional motion pictures or movies both by the scale of the production (multimedia is usually smaller and less expensive) and by the possibility of audience interactivity or involvement (in such case, it is usually called interactive multimedia). Interactive elements can include: voice command, mouse manipulation, text entry, touch screen, video capture of the user, or live participation (in live presentations).

Multimedia tends to imply sophistication (and relatively more expense) in both production and presentation than simple text-and-images. Multimedia presentations are possible in many contexts, including the Web, CD-ROMs, and live theatre. A rule-of-thumb for the minimum development cost of a packaged multimedia production with video for commercial presentation (as at trade shows) is: \$1,000 a minute of presentation time. Since any Web site can be viewed as a multimedia presentation, however, any tool that helps develop a site in multimedia form can be classed as multimedia software and the cost can be less than for standard video productions.

Objectives:

After studying this unit, you will be able to:

- Describe various concepts of Multimedia
- Explain History, elements and trends of Multimedia
- Explain New media communication technologies
- Analyze the future of Multimedia

1.1 History of Multimedia

Multimedia is an effective medium to express your ideas and present your information in more attractive way. As multimedia makes use of text, pictures, audio, animated characters people of all ages get attracted to it. It is an interactive medium of communication and entertainment. It allows the user to access worldwide information. Earlier newspaper was the first medium of communication to the large mass of people.

Text and graphics were used to make news attractive, but the use of newspaper was limited to educated peoples only. If the same information is presented using visuals then illiterate people can also understand it. Thus television and computer have become the most powerful communication tools in the twentieth century, which makes use of audio and video. Now

people can access to the worldwide events. In 1895, Guglielmo Marconi sent his first wireless radio transmission at Pontecchio, Italy. A few years later (in 1901) he detected radio waves beamed across the Atlantic. Initially invented for telegraph, radio is now a major medium for audio broadcasting.

Some of the important events in relation to Multimedia in Computing include:

- 1945 - Bush wrote about Memex
- 1967 - Negroponte formed the Architecture Machine Group at MIT
- 1969 - Nelson & Van Dam hypertext editor at Brown
- Birth of The Internet
- 1971 - Email
- 1976 - Architecture Machine Group proposal to DARPA: Multiple Media
- 1980 - Lippman & Mohl: Aspen Movie Map
- 1983 - Backer: Electronic Book
- 1985 - Negroponte, Wiesner: opened MIT Media Lab
- 1989 - Tim Berners-Lee proposed the World Wide Web to CERN (European Council for Nuclear Research)
- 1990 - K. Hooper Woolsey, Apple Multimedia Lab, 100 people, educ.
- 1991 - Apple Multimedia Lab: Visual Almanac, Classroom MM Kiosk
- 1992 - the first M-bone audio multicast on the Net
- 1993 - U. Illinois National Center for Supercomputing Applications: NCSA Mosaic
- 1994 - Jim Clark and Marc Andreessen: Netscape
- 1995 - JAVA for platform-independent application development. Duke is the first applet.
- 1996 - Microsoft, Internet Explorer.

1.2 Multimedia Elements

Multimedia is comprised of several elements including text, graphics, sound, video, and animation. Following are brief explanations of each multimedia element and how they can be used:

1.2.1 Text:

Text is perhaps the most fundamental element of any multimedia project. Text-based information can also be gathered from resource CDs and the

Internet. Applications such as Photoshop can be used to add visual effects to text to create a more appealing presentation.

1.2.2 Graphics:

Graphics can be incorporated into a multimedia project in the form of photographs or designs. Graphic images can be imported from a variety of resources such as the Internet, a digital camera, a scanner, or resource CDs such as Art Mania 12,000. Original graphic designs can be created with applications such as HyperStudio, MovieWorks, and Photoshop LE.

1.2.3 Sound:

Audio, or sound, is a multimedia tool that is frequently used for the purpose of e-Learning courses and training. In general terms, sound can be described as the “vibrations that travel through air and can be heard by humans”. Sound requires the use of different software to allow for the programming of this medium and when using sound in multimedia there are many options of technologies that can be utilised to edit the sound file including Real Audio, QuickTime and Flash. Real Audio is obviously used in the editing/programming of sound files, however it was specifically developed as a “streaming media format” which means that sound can be played even as it is being downloaded.

Sound can be added to a multimedia presentation from a variety of sources. Original sounds can be recorded using a microphone and programs such as SoundForge, MovieWorks, or Pinnacle Studio. These applications, as well as QuickTime Pro, can also be used to import sounds from an audio CD or the Internet. Sound resource files that can be used in multimedia projects are also included on the HyperStudio, MovieWorks, and SmartSound CDs.

The “QuickTime” software can also be utilised for not only video but sound as well because it is capable of ‘handling’ all different types multimedia formats. Flash, as described in the animation section, is a “powerful animation and presentation tool” (Extending Flash), and although there appears to be a focus on animation, it is still effective in improving the overall look and feel of multimedia, that is, through the use of sound. When using these technologies it is always important to know what type of software the learners have on their computers, as this will determine whether they will be able hear the sound files or access the multimedia appropriately.

Further issues that require consideration include reviewing what quality the learners' expect and determining the possibilities of the systems the learners will be utilising. When sound is used in e-Learning it is important to remember why the sound is included and whether it is necessary. Issues concerning the 'accessibility of sound' and the learners' understanding of their computers' software functionality also needs to be considered. This is particularly applicable in cases where the learners are hearing impaired and/or the learners don't possess the computer literacy skills to use the systems on their computers.

Multimedia elements such as animation, video and audio are all important components that add interest and significant value to not only e-Learning courses but to everyday life. It is through an understanding of the essential aspects of these multimedia elements, for example, how they are programmed and viewed, that one can derive an appreciation of the importance of these components to the online learning experience.

1.2.4 Video:

Moving images or video can be incorporated into a multimedia project as QuickTime movies. QuickTime Pro, HyperStudio, and MovieWorks can be used with a camcorder or VCR to create and edit QuickTime movies. These programs can also import movies from the Internet and from resource CDs such as The Archives of History. Movies that can depict a 360-degree panorama or a movable object can also be incorporated into a multimedia project. These virtual reality movies, often referred to as QuickTime VR movies, can be created with QuickTime VR Authoring Studio for playback and be incorporated into programs such as HyperStudio, MovieWorks, and QuickTime Pro.

Videos, like animation, are a key component of multimedia and result in greater interest and enjoyment for learners when incorporated in e-Learning courses. Although the definition of a video is quite well known in today's society, it is still important to review how literature describes this type of multimedia. Video is the "technology of capturing, recording, processing, transmitting and reconstructing moving pictures, electronic signals, or digital media, primarily for viewing on television or computer monitors".

As with animation, videos require programming, and this can be achieved through the use of a variety of software products including Premier,

Quicktime and Movie Player. “Premier Adobe” is the programming software that assists in editing videos, including the enhancement of colour. “Quicktime” has been described as ‘multimedia technology’ and is therefore utilised in the handling of all different types of multimedia, including videos.

When reviewing the quality of a video, this is determined by the frames per second used. ‘Frame rate’ is the number of “still pictures per unit of time of video” and can range from six to eight frames on older model cameras to 120 or more frames on new cameras. In its simplest form, that is, creating the ‘illusion of a moving object’, a video requires the frames to be a minimum ten frames per second.

It is important when creating learning to decide whether the video is essential to the learning or whether the same learning can take place without the expense of creating a video. There are several issues that need to be considered such as the increased difficulty of developing training materials through this medium. There are however, benefits from using this type of medium such as the easy storage of knowledge. The way the video is to be produced, for example the type of background to be used also needs to be considered, as it will affect the ability of the learners to engage in a positive or negative manner.

A further consideration when using video for learning purposes is the need to ensure that learners are provided with computer systems that can view the video the way it is meant to be viewed, for example, fast internet connection as well as compatible software. Finally, as with animation, video requires the use of a storyboard to convey the look and feel of the video before it is produced.

1.2.5 Animation - Graphics that contain movement are often referred to as animation. Animation files can be downloaded from the Internet in the form of animated GIF files and viewed with QuickTime Pro, HyperStudio, and MovieWorks. HyperStudio and MovieWorks can also be used to create and edit both frame and path animation.

The concept of animation is a key component of multimedia. Many e-Learning courses and learning programs have utilised animation to convey information and optimise learner engagement. Animation by definition is the “optical illusion of motion created by the consecutive display of images of static elements”.

Animation can enhance learning in an e-learning environment by allowing for greater participant enjoyment in their learning experiences. This will ultimately result in an increased willingness to participate in the learning, therefore contributing to greater learner participation.

Animation has advanced dramatically since the original format of hand written and black and white graphics, which emerged in the early 1990s. In today's "technology era", animation in all forms including training games, are 3 dimensional and a variety of colours are invariably used. Furthermore, animations are now mainly computer-generated rather than hand drawn. It can be seen in different examples of training games, eg Ad workshops negotiation game, that animation is still cartoon based but aims to be realistic in its portrayal of people and real-life situations. It is important to realise that although animation may be an effective multimedia medium it does require vast amounts of planning and preparation before a finished product is produced.

When multimedia games are being developed, there needs to be an outline or storyboard of what will be included before the game can be finished. The storyboard allows for greater clarification of what the animation will include and how it will work together as a series of images. This can be completed using computers or simply through hand drawing.

It is necessary to understand that animation requires the use of programs in order to function as a multimedia product. Animation can be programmed using a variety of software products including Flash, Director, C++, Visual Basic, GIF, all of which allow animation to be "viewed on a computer or over the Internet". Flash is software that provides an authoring environment in which interactive websites can be created (Adobe). From the late 1990s, Flash has been popularly utilised to add animation and interactivity to web pages subsequently in creating animation for e-Learning programs. Flash is a software program that is commonly utilised to create animations, design web-page elements and to enhance websites through adding video components.

GIF (Graphics Interchange Format) is another software product that can be utilised to program animation. GIF's can be described as 'compressed files' and have been widely accepted due to their ability to "reduce the amount of time it takes to transfer images over a network connection". GIF's are said to

support colour and various resolutions, which is an obvious necessity for effective animations. More specifically, GIFs are a format for displaying 'bitmap images' on the World Wide Web, and it appears that this program is advantageous for animation as it allows files to have 256 colours.

"Visual Basic" was created as a programming language and environment. It was one of the first products to provide an environment of graphical programming, and is thus very useful to the design and implementation of animation in an e-learning context.

C++, another form of animation programming software appears to be quite advanced compared to other programs previously mentioned. C++ is described as a 'high-level programming language' and is one of the most "popular programming language for graphical applications". From this information it can be inferred that C++ is a highly advanced programming device and therefore would be used for animations that involve detailed attributes. Finally, the animation program "Director" has been described as a 2-Dimensional multimedia animation program that enables users to create and import sounds and images and develop their movement over a period of time. It is said to have "been around for a long time". From this information it is within reason to infer that "Director" was one of the early programs used for animation, and most likely to have been prevalent when this form of multimedia was first initiated in the early 1990s.

1.3 Digital Multimedia

Digital multimedia is the field concerned with the computer-controlled integration of text, graphics, still and moving images, animation, sounds and any other medium where every type of information can be represented, stored, transmitted and processed digitally. Digital media represents a big investment and critical intellectual property for companies today. Digital media is not just video and multi-media. It's the publishing files for your marketing collateral . . . sales presentations . . . photography. It's all the digital content that helps you to communicate with your market.



Figure 1.2: Digital Multimedia

Companies today are trying to better leverage and get optimal value from their digital media--graphics, photos, image libraries, video, multimedia presentations, publishing files, and marketing materials. But the size, complexity, and specialized file types of this digital media content makes it difficult to put this content to us.

1.4 Analog and Digital conversion

Analog-to-digital conversion is an electronic process in which a continuously variable (analog) signal is changed, without altering its essential content, into a multi-level (digital) signal. The input to an *analog-to-digital converter* (ADC) consists of a voltage that varies among a theoretically infinite number of values. Examples are sine waves, the waveforms representing human speech, and the signals from a conventional television camera. The output of the ADC, in contrast, has defined levels or states. The number of states is almost always a power of two – that is, 2, 4, 8, 16, etc. The simplest digital

signals have only two states, and are called binary. All whole numbers can be represented in binary form as strings of ones and zeros.

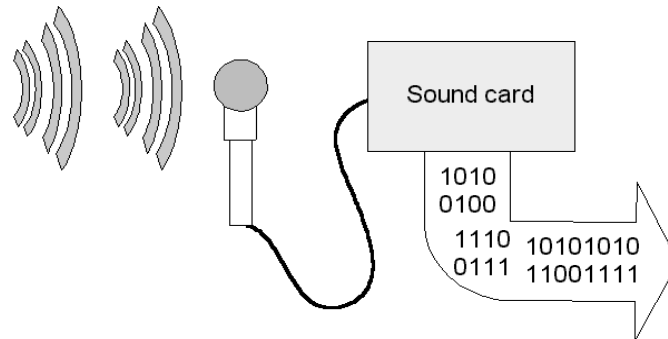


Figure 1.3: Analog-to-digital converter

Digital signals propagate more efficiently than analog signals, largely because digital impulses, which are well-defined and orderly, are easier for electronic circuits to distinguish from noise, which is chaotic. This is the chief advantage of digital modes in communications. Computers "talk" and "think" in terms of binary digital data; while a microprocessor can analyze analog data, it must be converted into digital form for the computer to make sense of it.

A typical telephone modem makes use of an ADC to convert the incoming audio from a twisted-pair line into signals the computer can understand. In a digital signal processing system, an ADC is required if the signal input is analog.

1.5 Digital media challenges

- **It's growing faster than any other type of content.** There are more devices and software creating it than ever before. And the demand for digital media consumption is growing. It has to be delivered wherever and whenever it's needed – so what was once file to print . . . NOW is file to print, web, handheld, even point of sale kiosk.
- **Digital media is created in one format, but it's consumed in many different formats.** So materials created for print need to be rendered differently for delivery to a cell phone. A sales person can't use a high resolution 10 MB Illustrator (.eps) graphic in their sales presentation. They need a lower resolution JPEG or a GIF. So do you create

3 different versions of the file? How do you get these out to everyone in every corner of the world where you market your products?

- **Digital media is not like traditional text-based content – it's visual and layered, and in the case of video – time-based.** So organizing and finding it can be a real issue. And managing the relationships between files and their subcomponents, like a publishing file with its related fonts, its images, text, and so forth – is important. For example, you have a product photo. That's one marketing asset. Then, that photo is in a brochure . . . a PowerPoint presentation . . . and a flash video on your website. If you update that photo, you want to automatically update every digital media file it's in.
- **Digital media represents a big investment and critical IP.** So security, rights management, and tracking digital media are very big concerns. And even more important, you want to make better use of it and maximize its value.

Digital Asset Management (DAM) product suite allows companies to get more value, and even monetize their digital media. These systems securely organize, share, and deliver this content to the right people, in the format they need – with secure, self-service access for extended teams.

To make this happen, you need an easy-to-use digital asset management solution, with a powerful security model, that readily integrates with other enterprise applications like Web content management, portals and workflow; with anywhere, anytime available.

1.6 CD-ROM Delivers

CD-ROM (Compact Disk Read-only Memory) sprang directly from the music CD and from the same set of parents – Sony and Phillips. It was a logical step: after all music CD stores a stream of electronic code that represents sound waves: replace that code with one that conveys digital pictures, text, animation and so on, attach a modified CD players to a computer, and you have CD-ROM.



Figure 1.4: CD-ROM

CD-ROM adaptation is designed to store computer data in the form of text and graphics, as well as hi-fi stereo sound. The original data format standard was defined by Philips and Sony in the 1983 Yellow Book. Other standards are used in conjunction with it to define directory and file structures, including ISO 9660, HFS (Hierarchical File System, for Macintosh computers), and Hybrid HFS-ISO. Format of the CD-ROM is the same as for audio CDs: a standard CD is 120 mm (4.75 inches) in diameter and 1.2 mm (0.05 inches) thick and is composed of a polycarbonate plastic substrate (under layer - this is the main body of the disc), one or more thin reflective metal (usually aluminium) layers, and a lacquer coating.

The Yellow Book specifications were so general that there was some fear in the industry that multiple incompatible and proprietary formats would be created. In order to prevent such an occurrence, representatives from industry leaders met at the High Sierra Hotel in Lake Tahoe to collaborate on a common standard. Nicknamed the *High Sierra Format*, this version was later modified to become ISO 9660. Today, CD-ROMs are standardized and will work in any standard CD-ROM drive. CD-ROM drives can also read audio compact discs for music, although CD players cannot read CD-ROM discs.

1.7 CD-ROM Data Storage

Although the disc media and the drives of the CD and CD-ROM are, in principle, the same, there is a difference in the way data storage is

organized. Two new sectors were defined, Mode 1 for storing computer data and Mode 2 for compressed audio or video/graphic data.

CD-ROM Mode 1

CD-ROM Mode 1 is the mode used for CD-ROMs that carry data and applications only. In order to access the thousands of data files that may be present on this type of CD, precise addressing is necessary. Data is laid out in nearly the same way as it is on audio disks: data is stored in sectors (the smallest separately addressable block of information), which each hold 2,352 bytes of data, with an additional number of bytes used for error detection and correction, as well as control structures.

For mode 1 CD-ROM data storage, the sectors are further broken down, and 2,048 used for the expected data, while the other 304 bytes are devoted to extra error detection and correction code, because CD-ROMs are not as fault tolerant as audio CDs. There are 75 sectors per second on the disk, which yields a disc capacity of 681,984,000 bytes (650MB) and a single speed transfer rate of 150 KBps, with higher rates for faster CD-ROM drives. Drive speed is expressed as multiples of the single speed transfer rate, as 2X, 4X, 6X, and so on. Most drives support CD-ROM XA (Extended Architecture) and Photo-CD (including multiple session discs).

CD-ROM Mode 2

Mode 2 is used for compressed audio/video information and uses only two layers of error detection and correction, the same as the CD-DA. Therefore, all 2,336 bytes of data behind the sync and header bytes are for user data. Although the sectors of CD-DA, CD-ROM Mode 1 and Mode 2 are the same size, the amount of data that can be stored varies considerably because of the use of sync and header bytes, error correction and detection. The Mode 2 format offers a flexible method for storing graphics and video. It allows different kinds of data to be mixed together, and became the basis for CD-ROM XA. Mode 2 can be read by normal CD-ROM drives, in conjunction with the appropriate drivers.

1.8 Data Encoding and Reading

The CD-ROM, like other CD adaptations, has data encoded in a spiral track beginning at the center and ending at the outermost edge of the disc. The spiral track holds approximately 650 MB of data. That's about 5.5 billion bits.

The distance between two rows of pits, measured from the center of one track to the center of the next track is referred to as track pitch. The track pitch can range from 1.5 to 1.7 microns, but in most cases is 1.6 microns.

Constant Linear Velocity (CLV) is the principle by which data is read from a CD-ROM. This principle states that the read head must interact with the data track at a constant rate, whether it is accessing data from the inner or outermost portions of the disc. This is affected by varying the rotation speed of the disc, from 500 rpm at the center to 200 rpm at the outside. In a music CD, data is read sequentially, so rotation speed is not an issue. The CD-ROM, on the other hand, must read in random patterns, which necessitates constantly shifting rotation speeds. Pauses in the read function are audible, and some of the faster drives can be quite noisy because of it.

1.9 Interactivity

We often talk about “being interactive” on the Web, but what does that really mean? Many journalists talk about “interactivity” as polls, quizzes, clickable graphics and multimedia presentations with multiple paths the viewer selects. That is to say, so a thousand people come in and play a sim-sim game to fix some problem but it ends there”. I don't call that interactivity. Interactivity is people interacting with people. In this new medium that the audience owns, it's about – pardon me for repeating myself – the people finally having a voice. It's about us in big media listening. News is a conversation.

Interactivity is the dialog that occurs between a human being (or possibly another live creature) and a computer program. (Programs that run without immediate user involvement are not interactive; they're usually called batch or background programs.) Games are usually thought of as fostering a great amount of interactivity. However, order entry applications and many other business applications are also interactive, but in a more constrained way (offering fewer options for user interaction).

On the World Wide Web, you not only interact with the browser (the Web application program) but also with the pages that the browser brings to you. The implicit invitations called hypertext that link you to other pages provide the most common form of interactivity when using the Web (which can be thought of as a giant, interconnected application program).

In addition to hypertext, the Web and many non-Web applications in any computer system offer other possibilities for interactivity. Any kind of user input, including typing commands or clicking the mouse, is a form of input. Displayed images and text, printouts, motion video sequences, and sounds are output forms of interactivity.

The earliest form of interaction with computers was indirect and consisted of submitting commands on punched cards and letting the computer read them and perform the commands. Later computer systems were designed so that average people (not just programmers) could interact immediately with computers, telling them what programs to run and then interacting with those programs, such as word processors (then called "editors"), drawing programs, and other interactive programs. The first interactive human-computer interfaces tended to be input text sequences called "commands" (as in "DOS commands") and terse one-line responses from the system.

In the late 1970's, the first graphical user interfaces (GUIs) emerged from the Xerox PARC Lab, found their way into the Apple Macintosh personal computer, and then into Microsoft's Windows operating systems and thus into almost all personal computers available today.

1.9.1 Elements of interactivity

According to Nathan Shedroff, interactivity, in terms of multimedia, can be defined by six major components:

- Feedback
- Control
- Creativity
- Productivity
- Communications
- Adaptivity

Feedback and Control

Invariably, the users of any e-learning course need to be provided with feedback about their performance in order to stay motivated and involved. Instant feedback is ideal, as it allows the learner to know where they went wrong as well as what they did well at the precise moment the information is required. Any delays in the receipt of feedback can reduce the significance or relevance of the feedback.

In an e-Learning situation, feedback can be provided using quizzes or problem solving activities where the learner is informed of how well they performed or if they answered questions correctly. Feedback can also be provided in a more personalised fashion, where an instructor provides some information regarding performance, rather than a generic right or wrong answer provided by the computer.

Control allows users to take initiative and choose how, what and when they learn, making the learning more relevant to them. If a course's design is limited to the passive participation of the learner, that is, all he/she can do is to sit back and watch, they won't be able to remain engaged for a lengthy period of time.

Control can be given to the learner by providing options and avenues using sophisticated navigation tools. For example, the learner may be given the option of forgoing participation in a learning module if they already have knowledge in that area, or they may have the option of choosing what learning activities they do, depending on their learning style.

Creativity and productivity

Despite the different qualities of these concepts, in the e-learning context, they share similar attributes. They both concern creating experiences which allow the audience to do something or make something. If users are given the opportunity to be involved in the creation of something, this may give them a sense of involvement and ownership which will give the learning more meaning.

An E-Learning course may involve elements of creativity and productivity by allowing the learner to practise producing the learning content in question. This can be done with the use of creation tools, and creation help. For example, in a course about HTML, the learner may be given a task where they can try out their coding skills and produce a web page of their own.

Communications

Shedroff jokes that the only thing that people love more than talking, is eating. He suggests that anything that can be done to allow the audience to communicate with one another; talk, listen, identify, share or tell stories, will make the site more successful and may build a learning community.

Humans are in fact social animals, and they feel better when they are in the company of other people and when they can share information with others. In relation to e-Learning, communication is very important, especially as e-Learning has the potential to be a very isolated activity, with learners often working alone at a computer instead of a social class-room based setting. This is why measures need to be taken in order to ensure that they do not feel alone and can communicate with their teacher and other students.

Shedroff says that all that is needed in order to start a learning community, is

- A way for people to talk to one another
- A way for people to consistently identify themselves and describe themselves and each other
- A topic around which to start a conversation
- Audience generated content

In an e-Learning environment, the topic around which to start a conversation is already established as the learning content. All that is required is some type of medium for communication, which can be a discussions board, a chat forum, bulletin boards, video conferences or even email access.

Adaptivity

Adaptivity means that the experiences change for each user so as to meet their specific needs, interests, skills and behaviours. By creating unique experiences for users, the problem and/or content will appear more personalized and interactive. This is a difficult task, but can be addressed quite effectively in an e-Learning context. The ways in which people learn can be identified and targeted. There are two surveys which can help identify what a learner's preferred learning style is, that is, VARK Learning Style Questionnaire Honey and Mumford Learning Styles Questionnaire.

The former identifies learners as either visual, aural, read/write or kinesthetic. Honey and Mumford's Questionnaire, identifies learners as activists, reflectors, theorists or pragmatists. Knowing what each of these preferences are and what activities are best suited to them, will allow instructional designers to suit every learner's needs. For example, there can be a voice which reads the text to the learner, or there may be two different types of learning activities for one topic, one which will suit kinesthetic

learners, and one which will suit read/write learners. There may be a discussion forum which is optional or a list of further research for those interested.

1.9.2 Creating Interactive material:

Many ideas for incorporating interactivity in learning materials have been explored in the previous section; however, James Kirk also has provided a number of suggestions. The following is a set of useful links he has investigated. A diverse range of sources are available for viewing on the internet, many of which provide comprehensive examples of interactive materials. For example, search engines like Google or Yahoo which can be used to search for games, tests, quizzes and simulations.

There are many online courses that can be visited as well including; Free Online Courses, Blackboard, and World Wide Learn. He also suggests looking at game and test sites which contain exercises that can be used without charge. One example is "The Lemonade Stand". By extension, Kirk talks about self assessment exercises and tests which can be found on websites that host useful exercises such as E-mode. However, before using any of the activities that have been created by someone else, it is necessary to ask for permission by contacting the person whose address appears on the homepage.

The other option is creating your own activities. Kirk lists several software programs which can be used for the creation of interactive activities. These include The Hot Potato Suite, Games Show Pro and Flash 5.

1.9.3 Using Interactivity Appropriately

It is important to note that interactivity enhances learning only when implemented correctly. In Learning and Training Innovations magazine, Will Thalheimer explains how interactivity enhances learning and how excessive use may hinder it. Knowledge of this area can help instructional designers to produce courses which draw on the positive aspects of interactivity and minimize the negatives.

In a typical learning environment, interactivity occurs when some aspect of the instruction prompts learners to respond with an answer or action. Thalheimer argues that while interactivity is present in learning designs, it is not the interactivity per/sec that causes the learning improvements, it is

something inherent in the interactivity. He describes the process through which interactivity effectively can lead to enhanced learning.

Interactivity promotes attentiveness. But it is not the attentiveness alone that causes learning, as attention can be paid to any irrelevant detail. It is attentiveness to particular relevant information that causes learning. Furthermore, feedback is used to promote learning, yet it is not the feedback itself, but the questioning and responding process that matters, as well as the information inherent in the feedback.

Therefore, according to Thalheimer, the reason interactivity promotes learning is that it prompts learners to retrieve information from memory, and it is this retrieval practice that prompts the learning improvements. Practicing the retrieval of information during the learning event, is the best way to ensure that it is retrieved from memory in an on-the-job situation. It is not the interactivity itself that enhances learning, it is the retrieval practice.

Thalheimer's analysis helps to understand why interactivity can hinder learning if it involves questions about non-essential information. When designing learning activities, instructional designers need to consider:

1. Is the information that the learners is asked to retrieve, relevant?
2. Is it important?
3. Is it realistic?
4. Does it emphasise the learning or divert focus away from the learning?

Gerry McGovern explains another problem relating to interactivity on the internet. He suggest that it is the removal of people – with the consequent reduction of interactivity and community that has attracted many businesses to the web, as when people are removed, so are costs. The web is naturally an environment low on interactivity and community, therefore creation of these features is not as simple as just installing chat or discussion board software. The real work involves getting people to interact. This can be achieved through giving a sense of meaning, content and togetherness amongst the people involved, before giving them a means of interaction.

1.10 Internet Vs Multimedia Vs entertainment

The internet is poised to make some huge change with multimedia and entertainment. It's happening as we speak. We've watched the music

revolution, the digital music revolution, and the change in the way music is sold. Now, CDs are disappearing. They're unnecessary.

It's going to continue. Television shows will be seen on the internet. You may even find more viewers on the internet than you will on the actual television channels. You'll see movies distributed on the internet. You'll see movies distributed to theatres and the internet simultaneously. You'll be downloading your movies directly to your computer. Then, it will change even more. As the home entertainment environment grows wings and starts to fly, you'll have things like the iPod that can show you TV shows, video, and music and they'll be able to surf the internet; it'll change from there.

You'll have your photos, which are digital, able to be viewed on computer screens placed around your house, where your computer tells which computer screen to show the particular slide show from one of your Hawaii vacations or of family pictures, and you can do it at the flick of a finger; at the touch of a button. You're going to see devices like the iPod become multimedia storage hubs with remote control sensors that'll allow you to point your iPod or other MP3 device at a television screen, click a button, and wirelessly display content from the internet or from the iPod onto the TV screen.

You'll also be able to point it at a wall and set it up as a projector or onto one of the picture TV screens. Your photos will stop being something that's a static thing, and start being something that's dynamic and alive, and so will the movies, the music, and the TV shows. All of it will become handheld and will travel with you, and you'll be able to watch that show you want to see, that movie you want to see, look at the pictures you want to see or browse the internet from anywhere you go in the world, all off of a device that can be held in the palm of your hand, smaller than a deck of cards.

1.11 Multimedia Applications

Multimedia software emerged in the mid-eighties, soon after the CD-ROM was invented. CD-ROM, with its vast storage capacity, has been compared in significance to paper, the printing press, and photography. By the early 1990's the multimedia phenomenon was gathering momentum and attracting great media interest; by the mid 1990's multimedia software was finding its place on the Internet. Even if multimedia does not live up to all the

hype, it is already a multibillion-dollar industry, creating hundreds of new titles each month.

Multimedia has become a huge force in American culture, industry and education. Practically any type of information we receive can be categorized as multimedia, from television, to magazines, to web pages, to movies, multimedia is a tremendous force in both informing the American public and entertaining us. Advertising is perhaps one of the biggest industry's that use multimedia to send their message to the masses. Where one type of media, let's say radio or text can be a great way to promote an item, using multimedia techniques can significantly make an item being advertised better received by the masses and in many cases with greater results.

Multimedia in Education has been extremely effective in teaching individuals a wide range of subjects. The human brain learns using many senses such as sight and hearing. While a lecture can be extremely informative, a lecture that integrates pictures or video images can help an individual learn and retain information much more effectively. Using interactive CD ROM's can be extremely effective in teaching students a wide variety of disciplines, most notably foreign language and music.

Most of the multimedia titles produced today are designed for home use. These titles fall into three broad categories: reference, which brings the resources of the public library into the home; education, which supplements classroom schooling; and entertainment. Within each category, certain genres have been established; the cartoon adventure and the interactive movie, for example, are both well defined strands of entertainment software. A fourth category, services, covers wider multimedia application: in workplaces, public galleries, shopping malls and even airplanes.

1.12 Use of Multimedia in the Classroom

The appropriate use of multimedia can enhance understanding and indeed provide additional information. However, some sites include multimedia such as Flash introductions, which at best are annoying and at worst put off the client due to the delays caused. If the connection to the Internet is not fast broadband, then the delays can be intolerable.

Multimedia activities encourage students to work in groups, express their knowledge in multiple ways, solve problems, revise their own work, and

construct knowledge. The advantages of integrating multimedia in the classroom are many. Through participation in multimedia activities, students can learn:

- Real-world skills related to technology
- The value of teamwork
- Effective collaboration techniques
- The impact and importance of different media
- The challenges of communicating to different audiences
- How to present information in compelling ways
- Techniques for synthesizing and analyzing complex content
- The importance of research, planning, and organization skills
- The significance of presentation and speaking skills
- How to accept and provide constructive feedback
- How to express their ideas creatively

A growing number of online universities offer multimedia learning components such as chat rooms, collaborative projects, and web conferencing. These multimedia components can help online students effectively master the subject matter. But, multimedia learning also has a downside: inexperienced students can easily become distracted with the platform instead of the subject. It's easy to waste time chatting on course message boards or tuning out a podcast lecture.

Collaborative Projects: New web applications make it easy for multiple students to work together on an online project such as an essay or a visual. **The Multimedia Challenge:** Collaborating on a group project over the internet can be more difficult than working together in-person. Group members are more likely to squabble over minor details and demand their own way.

The Solution: Try to keep the number of group members to a minimum. Spend your first group meeting dividing tasks and setting some ground rules. If you find someone you feel comfortable working with, try to be in the same group as often as possible.

Email: Email accounts make it easy for your peers and professors to contact you, even if you're not online. **The Multimedia Challenge:** Email is one of the biggest time wasters. As you develop a rapport with your

classmates, expect your inbox to be filled with messages unrelated to your studies.

Message Boards: Message boards allow students to create thought-out responses to discussion questions. As the discussion threads are generally saved, message boards become a resource when studying for exams and writing papers.

The Multimedia Challenge: When message board posts are mandatory they often become stale restatements of previous posts. **The Solution:** If you are required to post, take the time to think before you write. The beauty of message boards is that, unlike chat rooms, an immediate response is not necessary. Browse through previous posts to make sure that you are adding something unique to the discussion.

Podcasting: Podcast lectures let you listen to your professor at any time and any location. You don't have to worry about missing an important detail because you can listen to podcasts as many times as you want. **The Multimedia Challenge:** Because students know that they can have a "second chance" to listen, it is tempting to tune out and miss the information presented in podcasts.

Videos: Watching a video lecture makes it possible to see and hear your professor, as though you were attending a lecture in real life. Unlike podcasts, video lectures allow students to view demonstrations and pick up on visual cues.

Web Conferencing: Web conferencing allows students to talk with their professor in real time. Web conferences vary, but often students are able to see their professor (or conference presenter) on the screen and chat using headsets.

1.13 Multimedia Application: Design Training, Entertainment

Multimedia is one of the most fascinating and fastest growing areas in the field of information technology. Text, pictures, animation, movies and sound – all these varied media are seamlessly blended, resulting in simple slide shows to dazzling, interactive presentations. Before the advent of computers, multimedia projects were difficult to put together. Computers

enable to combine the media and can be stored for reuse. Multimedia is widely used in entertainment and education.

Multimedia Application: Multimedia can be used for entertainment, corporate presentations, education, training, simulations, digital publications, museum exhibits and so much more. With the advent multimedia authoring applications like Flash, Shockwave and Director amongst a host of other equally enchanting applications, your multimedia end product is only limited by your imagination.

Multimedia Design Training: Multimedia presentations are a great way to introduce new concepts or explain a new technology. In companies, this reduces the Design and Training time of multimedia. Individuals find it easy to understand and use.

Multimedia Entertainment: The field of entertainment uses multimedia extensively. One of the earliest applications of multimedia was for games. Multimedia made possible innovative and interactive games that greatly enhanced the learning experience. Games could come alive with sounds and animated graphics.

Multimedia Business: Even basic office applications like a word processing package or a 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.

Miscellaneous: Virtual reality is a truly absorbing multimedia application. It is an artificial environment created with computer hardware and software. It is presented to the user in such a way that it appears and feels real. In virtual reality, the computer controls three of the five senses. Virtual reality systems require extremely expensive hardware and software and are confined mostly to research laboratories.

Videoconferencing: Videoconferencing is conducting a conference between two or more participants at different sites by using computer networks to transmit audio and video data.

1.14 Hypertext /Hypermedia

Hypermedia is a similar arrangement of interconnected information from two or more media. Hypertext systems were among the earliest forms of

multimedia. They have endured mainly because hypertext software is relatively simple and provides for a degree of user interaction. The extension of hypertext to hypermedia followed once computer systems were able to handle both text and other media. While still used for their original purposes, hypermedia-like systems and controlling actions are often used in multimedia authoring, but a different aspect has suddenly become of major interest. Retrieval on Internet's World Wide Web is aided by hyperlinks between information entities (nodes). In fact the wide reach provided by this facility is probably the reason for the Web's success.

Hypermedia, a term derived from hypertext, extends the notion of the hypertext link to include links among any set of multimedia objects, including sound, motion video, and virtual reality. It can also indicate a higher level of user/network interactivity than the interactivity already implicit in hypertext.

In order to understand how to approach hypermedia development, we need to understand what we mean by the term hypermedia development. In order to understand hypermedia development, we need to understand what we mean by the hypermedia application which we are developing. In other words, by developing an understanding of hypermedia which extends beyond a mere collection of technical wizardry and flashy displays, we will provide a context in terms of our interpretation of the purpose/goals of hypermedia which allows us to develop an understanding of how to most effectively approach the development of the next generation of truly effective hypermedia applications.

The term "hypermedia" is becoming more and more widespread. But what exactly is hypermedia? This sounds like a relatively simple question. It is not! Along with terms such as hypertext and multimedia it is bandied about the press as though it were a cure-all for all information management woes. Despite this, or possibly partly because of it, the term is still rather ill-defined. Before trying to identify or develop a useful definition let us divert for a moment and consider the way that human memory works.

Hypertext became widely known in the late 1980s because Apple supplied a free copy of Hypercard software with its machines. Academics latched on to it as it encouraged a breakaway from linear text and encouraged browsing by linking related parts of a document without the need for footnotes or 'see' references. One curious outcome was that certain problems associated with

indexing, described as 'navigating' to evade the boredom engendered by that word, could result in a user getting lost in a network of interlinked items. Hypertext was later pressed into service as a convenient form of multimedia control for the presentation of text, sound, music, voice, graphics, pictures, animation, or motion video. Simple programs using English words may be used. Hypertalk Script writing, composition in a standard form, but consisting of English words and phrases arranged and used in order to create a command protocol, requires a longer learning commitment but is still relatively easy.

Hypertext is a class of software for exploring information, usually mainly text, by alternative paths as opposed to the fixed path or structure found in conventional printed systems. In its simplest form, text is split up into small chunks, each displayed on what appears to be a card. The linear arrangement of information, as in a book, is not always the most convenient to use. A feature of hypertext is the provision for jumping from one piece of information to another.

Multimedia interest in Hypercard centres on access to third-party software. A command is a message containing a keyword which will cause the script for an object containing that keyword to be executed. A function is some kind of instruction. External Commands (XCMD) cause a 'resource', or code module, written in Pascal or Assembly language, to be executed by a command message. An XCMD may be used to control driver inter-operable software associated with an external device such as a videodisk player.

Hypercard was preceded by and co-exists with a number of older systems which are broadly similar. Hypercard, or one of its more recent alternatives such as Supercard or Hyperdoc, is a convenient method to control multimedia material such as text, sound, music, voice, graphics, pictures, animation, or motion video. Hypercard, which started as a hypertext system, soon became a hypermedia system with version 1.2, introduced in late 1988. This version included some improvements taking it into the multimedia area – for instance, for using data from a CD-ROM drive connected to the Mac, with disks which included text, sound, and music data.

1.15 Hotspots

Most multimedia titles make use of hotspots. A hotspot is usually a button or picture that reacts when you select it – by taking you to another part of the title. Most hotspots are revealed by exploring the screen with the mouse and observing where the pointer or image changes. Another type of hotspot is hot text – a word or phrase that appears in a different colour from the main text to show that it is live. Not all hotspots declare themselves; however, sometimes you have to click around the screen to find them.

A hotspot is any public area where computers that have been fitted with wireless network technology can gain access to the Internet. The computer accomplishes this by contacting a nearby wireless network with its internal NIC (Network Interface Card). The NIC seeks out the radio waves generated by wireless networks. When it detects a signal strong enough, it asks permission to log on to the network. Though this access is often free, other times the wireless network requires registration and a small fee before it will grant the computer access.

Many cafés now feature a wireless network environment or hotspot, so that customers can sit leisurely, sip coffee and work on their laptops with full Internet access. Establishments that offer hotspots are referred to as being wired, somewhat of a misnomer since the technology is wireless.

A network that generates a hotspot basically consists of a wireless router and modem. The RF, or radio frequency, waves used by a wireless network extend in all directions from the central location of these devices, before finally weakening through interference and lack of signal strength. If a computer is inside the 'shroud' of RF waves, it will have the capability to connect to the network. This area is the hotspot. As the computer moves further away from the router and modem devices, the connection will become weaker and slower. The quality of the connection deteriorates rapidly at the boundary. The computer will lose access completely if it leaves the hotspot.

A hotspot might not be specifically generated for public use. All wireless networks generate RF waves and hotspots. A hotspot can be available outside of a commercial building, for example. In this case, the wireless network is not specifically set up to service public clients, so access will be free. The user is more or less hitchhiking to the Internet. However, a firewall

installed in the router may prevent unauthorized access of the hotspot by requesting a username and password before granting access to the Internet.

Many cities such as Hermosa Beach, California, have installed wireless networks for their citizenry and visitors by creating a large, free hotspot that covers a specific area of the city. People can park in such areas and use laptops to do online business, collect or send email, or hop on to a VPN (Virtual Private Network). Gaining access to the Internet from a vehicle can be extremely handy. When travelling, one can pull over to look up directions or phone numbers, or to get traffic or flight information, among countless other uses.

Most NICs (Network Interface Card) make it quite easy to find a hotspot. They feature a configuration screen that scans automatically for networks in the area. By glancing at the graphic bars that indicate signal strength, one can head in the direction of greater strength.

Wireless technology is very affordable and convenient. Current laptops come with NICs preinstalled. Older laptops can be fitted with external NICs that slide into one of the PCMCIA slots, or a USB port. In just minutes you can be tracking down a hotspot on the fly, or surfing the Internet while enjoying a hot cup of java at the local wired café.

1.16 Digital Encyclopedia

Encyclopedia have existed for almost 200 years. Multivolume printed editions, such as those published by Encyclopedias Britannica or the Academic American Encyclopedia, have been used in schools and homes as reference sources throughout the 20th century. But the power of CD-ROM to store enormous amounts of information that can be searched in an almost infinite number of ways was quickly harnessed by encyclopedia publishers. As the multimedia CD-ROM revolution got under way, encyclopedia publishers stepped in, and by the mid-1990s most of the major printed encyclopedias had been released as CD-ROM titles.

In other words, Encyclopedia or encyclopædia is a comprehensive written material that contains information on either all branches of knowledge or a particular branch of knowledge. Encyclopedias are divided into articles with one article on each subject covered. The articles on subjects in an

encyclopedia are usually accessed alphabetically by article name and can be contained in one volume or many volumes, depending on the amount of material included.

Indeed, the purpose of an encyclopedia is to collect knowledge circulated around the globe; to set forth its general system to the men with whom we live, and transmit it to those who will come after us, so that the work of preceding centuries will not become useless to the centuries to come; and so that our offspring, becoming better instructed, will at the same time become more virtuous and happy, and that we should not die without having rendered a service to the human race in the future years to come.

Single subject encyclopedia have two advantages over the general sort: first, being narrower in scope, they can go much more details; and second, they often present information in a more interesting way. The way a title presents information, its “look and feel”, is known as its interface. General encyclopedias include so many different types of information that they have to use all-purpose interfaces, which are often fairly bland. One-subject titles, however, can build information into a graphical world specially created to entice the user into it.

1.17 Browsing the World of information

One of the most common reference book at home is the atlas. Multimedia atlas present the same information in a more dynamic and involving way. Navigation around the world is made easy and every country is brought to life with multimedia features such as sound, animation, satellite and time-laps photography, and video clips. With a good multimedia atlas you can search for a place-find yourself taking a trip from Andodara to Australia or from Zagreb to Zanzibar simply because desktop travelling can be so addictive.

1.18 Multimedia Atlases

Like the book atlas, the multimedia version contains maps, illustration, tables and statistical data relating to the whole world, as well as to regions and countries. Multimedia’s unique twist is that it uses sound, video, and animation to present this information more vividly. It also allows the user to make a large number of choices about the way each map is displayed.

1.19 Control the World

With many titles, you can decide how much detail and what kind of details you want to see on screen. The scale of maps can be adjusted using zoom buttons. You can also choose the features that appear on the maps, or you can add new locations. Most multimedia titles contain large databases of statistical information. This information can be very wide-ranging from data on total urban population to the number of radios per thousand people in any country. You can usually display and print the answers to any query in a number of ways.

1.20 Multimedia Future and Emerging Technologies

As technology progresses, so will multimedia. Today, there are plenty of new media technologies being used to create the complete multimedia experience. For instance, virtual reality integrates the sense of touch with video and audio media to immerse an individual into a virtual world. Other media technologies being developed include the sense of smell that can be transmitted via the Internet from one individual to another. Today's video games include bio feedback. In this instance, a shock or vibration is given to the game player when he or she crashes or gets killed in the game. In addition as computers increase their power new ways of integrating media will make the multimedia experience extremely intricate and exciting.

1.21 Social Software

'Social software is now used to define software that supports group interaction'. Although this definition may appear to be very broad, it captures the term precisely. For example, social software encompasses many online communication modes including instant messaging, blogs and email. Some people argue that the term is restricted to more recent software genres such as blogs and wikis. However, it is widely agreed that the communication made possible by the software is socially significant. It is this software that allows people to form online communities, where they can connect and collaborate.

Social Software for the future of e-learning

'Learning is a process of connecting specialised information sources, maintaining connections is needed to facilitate learning and the core skill of learning is the ability to see connections between ideas and concepts'. This

is the idea behind a new theoretical approach introduced by George Siemens (2005). It is argued that social software creates a means by which people can connect, and if people are interacting and sharing ideas, learning will occur. In this way, if maintaining connections is needed to facilitate learning, then it is within reason to argue that social software is one such development that will have a fundamental presence and perhaps even direction over the future of e-Learning innovations.

Mobile Learning

Mobile Learning or m-Learning is defined as “using mobile technologies, including mobile phones and hand held devices to enhance the learning process” (m-learning). It describes ‘the new possibilities that are available to people given the mass deployment of devices that everyone has in their hands and the new connectivity’s that are coming’.

The promotion of hand-held learning devices has a background of more than four years of research and development. It has subsequently helped thousands of learners from different backgrounds to develop their skills, confidence and motivation to learn (m-learning).

In an examination of the potential of m-Learning use within the workplace, the study found that mobile learning resources inspired employees to suggest ‘new ideas for the incorporation of technology in the workplace, including education and interpretation programs’ (Australian Flexible Learning Framework). These results supported the argument that participants’ interest levels in m-Learning were extremely high, and allowed them to take responsibility for their own learning and development.

Academics are now beginning to acknowledge the importance of m-Learning. For example, the “new generation” of young individuals or the present and future participants of e-Learning interventions, has been described by one professor as ‘always on, one handed texting, instant messaging and multi-tasking’. If then this new generation are so fascinated by the latest in technological advancements, then this revelation can be seen as a huge opportunity for learning to be introduced in a mobile context. As “mobile” implies that the technology is wirelessly connected, this means that learners are not restricted to one learning environment. People want to have as much control over their own learning as possible and m-Learning allows them to access information anywhere and at anytime.

Inspirational m-learning projects have taken place across Australia in a variety of learning contexts, demonstrating the flexibility of this learning medium. Feedback from both learners and facilitators involved has been positive in response to m-learning (m-learning).

Wireless Technologies

The term, “wireless technologies” by its very terminology, is self explanatory and can be likened to m-Learning to some extent. For example, in a similar operational sense as m-Learning, wireless technology allows the learner to access information at their convenience.

An example of wireless technology is iBurst, which offers wireless broadband internet. This allows learners to access the internet at any location. Once again, the convenience of this technology motivates people to learn at their own pace and in an environment that suits them. As stated previously, learning is about connecting.

The merits of learning through technology has been argued in a recent Sydney Morning Herald article, informing readers that technologies like iBurst is fast enough to allow cheap telephone calls over the internet, and as speeds increase, will be able to handle ‘video-on-demand’ (Sydney Morning Herald). In this way, iBurst represents an inexpensive and effective learning tool, one that, for example can be utilised in place of locating and transporting managers worldwide for a national training conference.

The Wireless e-Learning and Collaboration (WEC) solution is another example of wireless technology. Students and teachers are given mobile access to course content, administrative tools and academic resources. The WEC solution allows teachers to manage their students more effectively; to have more control over course content and communicate with colleagues easily.

RSS

RSS or *Really* Simple Syndication is a useful tool for keeping updated on your favorite websites. RSS makes use of an XML code that constantly scans the content of a website for updates and then broadcasts those updates to all subscribers through a feed. RSS feeds are typically used with news sites or blogs, although any website can use them to disseminate information. When an update is sent out, it includes a headline and a small

amount of text, either a summary or the lead-in to the larger story. You will need to click a link to read more.

In order to receive RSS feeds, you must have an aggregator, a feed reader. There are a number of aggregators online, many of them free, so with a little bit of searching, you should be able to find an interface that appeals to you. In addition to being available on your computer, RSS feeds can also be read on PDAs and cell phones.

When you come across a website you would like to add to your aggregator, you can do so in one of two ways. Most sites that offer an RSS feed have an "RSS" or "XML" button on their homepage that you can click on and it will instantly add that feed to your aggregator. Depending on your aggregator, you may instead need to copy and paste the URL of the feed into the program.

An article from learning circuits clearly specifies ways in which RSS, or similar tools, can be used to enhance learning. It describes methods that instructors may use for or in courses including:

1. Subscribing to feeds on certain topics to keep informed
2. Publishing syndicated content on course websites or weblogs
3. Having learners create their own weblogs and subscribing to feeds of all those weblogs to ascertain new content
4. Notifying learners about new available courses
5. Updating learners on new internal or external resources available on a training topic and,
6. Subscribing to feeds from learning object repositories to ensure that the most current objects are added .

Instant messaging (IM)

IM is an acronym for Instant Messaging. It is 'a tool that successfully supports informal communication'. A form of IM is SMS technology. In an example of IM in practice, IM in its SMS form has proved to be extremely effective amongst a group of hearing impaired students. With the assistance of IM technology, these students were able to communicate in real time and use this medium as a tool to facilitate communication with their teachers without the support of an interpreter.

The most common use of IM within an e-learning context has been to produce a cooperative learning environment. Users of IM are said to be able to articulate ideas, issues and opinions in real time. As such, IM can be used to engage and maintain learner interest as correspondence occurs in a timely manner. Although some people may become confused by chat dialogue or the functionality of chat room discussion, it would appear that the positive facets of IM far outweigh this limitation.

Challenges facing organisations are to find other ways to engage and become part of the emerging technologies (Videolinq). SMS is a synchronous learning object which in an e-learning context can provide the student with real time and instant learning opportunities. SMS or IM, as a real-time communication tool can also be utilized as a delivery option for hearing-impaired students. This allows them to access teachers without a third party to interpret. Learners can also use this to get automated feedback from assignments or questions, freeing the tutor from any additional workload.

WIKIS

A wiki is a web space that is developed by a group of people. Content displayed on a wiki can be constantly modified, with changes being recorded as the content is updated. The wiki is a simpler process of creating HTML pages, and provides tools by which individuals can discuss wiki content and alterations. By keeping records of all modifications, wiki creators may at anytime change the content and/or the site's functionality to its previous state. The main concern with a wiki system is that some content can often be false or misleading.

Wikis can also be used to support the collaboration of learners. A wiki functions with the intent of sharing and exchanging knowledge. In this way, learners can develop a more comprehensive understanding of all the issues in question. As such, those "who are not given a voice", can feel empowered by having the opportunity to build on their knowledge and can subsequently derive a sense of involvement. Group interaction is also promoted as there are set documents that reflect the shared ideas of the learning group.

Weblogs:

Weblogs allow organisations to develop an insight into the minds of their employees, and "are potentially powerful for establishing truly 'personal'

support for individual and collaborative learning inside and outside of formal institutions". Weblogs are inexpensive for organizations to establish and promote self organised collaborative learning.

Examples of Weblogs being used in educational or organisational e-Learning contexts include the "Ed-Tech Insider" and Christopher D Sessums' weblog. "Ed-Tech Insider" is a weblog that was created to dispense free information regarding school news (Bloglines). On the other hand, the weblog developed by Christopher D. Sessums, examines formal learning management systems and component-based learning environments.

Social Tagging:

Social tagging or "bookmarking" is similar to an online favorites list developed by an individual but has the additional functionality of allowing others to access this list. The individual will use tags, or user defined keywords, that link to each resource. Others may then search resources based on these keywords. Unlike search engines such as "Google", listings of resources appear in terms of their usefulness to the learner, that is, with a ranking ascribed to the resource according to its perceived usefulness, as opposed to the resource that has a number of hyperlinks directing the user to the site in question. In this way, social tagging can enhance learning dramatically as each resource is ranked by individuals who rate the site's usefulness. As a consequence, this eliminates any resource that offers little information and therefore learners not only save time but their confusion is reduced.

Social tagging may also enhance learning as valuable resources are shared. For example, a lecturer of Penn State College had created a social bookmark activity for his students. The students created an account through a social bookmarking site called del.icio.us. Each week students were asked to submit at least two new resources to their bookmark. They were also advised to use a common keyword when tagging sites related to the class. This exposed the students to a whole new world of sharing knowledge and collaborative learning. As students explained why each site was useful to their learning, other students can learn to appreciate the understandings that their peers had derived, subsequently contributing to their own learning experiences (Apple Education Communities).

Podcasts

'Pod casting is the method of distributing multimedia files, such as audio programs or music videos, over the internet for playback on mobile devices and personal computers'. Simple examples include the constantly updated news video features available through ninemsn and footage of the 106.5 radio crew on a daily basis.

The Education Podcast Network allows teachers to connect and collaborate via a podcast. They can view podcasts created by academics within their field of expertise, and are also given the opportunity to produce their own programs. In this way, podcasting enables the participating teachers to 'share their knowledge, insights, and passions for teaching' (Education Podcast Network).

Furthermore, podcasting has the functional capacity to assist students' learning. For example, podcasting not only provides teachers with the flexibility to post important segments of their lectures online, or their interviews with experts, but can allow students to view footage of museums and/or conferences. Students can even create their own podcasts on material covered in class, or in their textbooks (University of Illinois News Bureau).

Self Assessment Questions

- 1) _____ proposed the World Wide Web to CERN (European Council for Nuclear Research)
- 2) Multimedia is comprised of _____.
- 3) Graphics that contain movement are often referred to as _____.
- 4) GIF stands for _____.
- 5) _____ conversion is an electronic process in which a continuously variable (analog) signal is changed, without altering its essential content, into a multi-level (digital) signal.
- 6) _____ is the dialog that occurs between a human being (or possibly another live creature) and a computer program.
- 7) _____ is a similar arrangement of interconnected information from two or more media.

1.22 Summary

- 'Multimedia' supposedly means 'The processing and presentation of information in two or more media', so computers which are capable of handling text and simple graphics, available for many years, could be called 'multimedia computers'.
- Multimedia tends to imply sophistication (and relatively more expense) in both production and presentation than simple text-and-images.
- Multimedia makes use of text, pictures, audio, animated characters people of all ages get attracted to it.
- Graphics can be incorporated into a multimedia project in the form of photographs or designs.
- The "QuickTime" software can also be utilised for not only video but sound as well because it is capable of 'handling' all different types multimedia formats.
- Moving images or video can be incorporated into a multimedia project as QuickTime movies.
- Videos, like animation, are a key component of multimedia and result in greater interest and enjoyment for learners when incorporated in e-Learning courses.
- Graphics that contain movement are often referred to as animation.
- The storyboard allows for greater clarification of what the animation will include and how it will work together as a series of images.
- Graphics Interchange Format is another software product that can be utilised to program animation.
- Digital multimedia is the field concerned with the computer-controlled integration of text, graphics, still and moving images, animation, sounds and any other medium where every type of information can be represented, stored, transmitted and processed digitally.
- Analog-to-digital conversion is an electronic process in which a continuously variable (analog) signal is changed, without altering its essential content, into a multi-level (digital) signal.
- Digital Asset Management (DAM) product suite allows companies to get more value, and even monetize their digital media.
- Interactivity is the dialog that occurs between a human being (or possibly another live creature) and a computer program.

- Hypermedia is a similar arrangement of interconnected information from two or more media.
- RSS or *Really* Simple Syndication is a useful tool for keeping updated on your favorite websites.

1.23 Terminal Questions

- 1) What is Multimedia?
- 2) Briefly explain elements of multimedia.
- 3) How digital media's are useful in day to day life?
- 4) What is internet?
- 5) Briefly explain hypertext and hypermedia.

1.24 Answers

Self Assessment Questions

- 1) Tim Berners-Lee
- 2) Text, graphics, sound, video, and animation
- 3) Animation
- 4) Graphics Interchange Format
- 5) Analog to digital
- 6) Interactivity
- 7) Hypermedia

Terminal Questions

1. Multimedia is more than one concurrent presentation medium (for example, on CD-ROM or a Web site). (Refer section 1.0)
2. Multimedia is comprised of several elements including text, graphics, sound, video, and animation. (Refer section 1.2)
3. Digital multimedia is the field concerned with the computer-controlled integration of text, graphics, still and moving images, animation, sounds and any other medium where every type of information can be represented, stored, transmitted and processed digitally. (Refer section 1.3)
4. Internet is a network of networks. (Refer section 1.10)
5. Hypermedia is a similar arrangement of interconnected information from two or more media. Hypertext is a class of software for exploring

information, usually mainly text, by alternative paths as opposed to the fixed path or structure found in conventional printed systems. (Refer section 1.14)



Unit 2

Concepts of Drawings

Structure

- 2.1 Introduction to Drawing
 - Objectives
- 2.2 Elements of drawing
- 2.3 Creating Drawing
- 2.4 Types of drawing
- 2.5 Drawing Composition
 - 2.5.1 Depth Cues
- 2.6 Perspective Drawings
- 2.7 Multi View Drawing
- 2.8 Diagrams
- 2.9 Presentation Drawings
- 2.10 Summary
- 2.11 Terminal Questions
- 2.12 Answer

2.1 Introduction to Drawing

Drawing has always been the essence of most art forms. Since the beginnings of mankind it has always been the closest form to nature. It is another form of language to express nature, creativity, (creativity which comes from nature and what we see) and mankind. As infants we begin to draw before we even learn to write. As we grow up, at some time or the other in our life, we have the urge to draw something. In its simplest form, drawing consists of making a mark or leaving a trail on a surface.

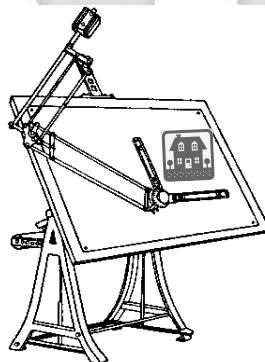


Figure 2.1: Drawing Table

Drawing has a number of primary functions that differ according to the intended outcome. Primarily, drawing is seen to be any form of marking a surface with a view to creating a two-dimensional image. Common tools used for drawing upon a two-dimensional surface include pencil, coloured pencils, graphite, charcoal, compressed charcoal, ink, pastel, wax crayon and oil pastel. Drawing is sometimes used as a preparation for a painting, either as an observational sketchbook exercise or as a preliminary to painting upon canvas, as a means of mapping out where different areas of colour will go.

For this reason it has a close relationship with painting, and even crosses over with it, as some ink and brush techniques differ little from painting at all: In these instances it becomes clear that drawing is generally seen to be a process of drawing with 'line' using an implement that creates friction with the surface, thus leaving a mark on that surface.

The principle aim of drawing is to record events, images or ideas using the friction between the drawing implement and the draw-upon surface to leave a mark that can be referred to in the future for reference or entertainment.

There are several broadly differing types of drawing that all employ the above means of recording phenomena. Principally they do not differ that much and some forms even cross over into one another. For example, graphic design, whilst being methodical in its approach and having a defined purpose can be appreciated as art. Similarly, art can be used to inspire design, as can often be seen in fashion and architecture.

Drawing is principally comprised of tone, line and (sometimes) an awareness of 'perspective' (the illusion of three-dimensional space). It sometimes utilises colour, although this is seen as a secondary component of drawing, as colour is the principle domain of painting, and now colour photography.

Using the elements of tone, line and perspective attempts are made by artists to convey 'reality' in a manner that is 'expressive' or in a way that is more realistic (often called 'academic drawing' or 'realist' drawing). In both cases an attempt is made to convey an existing reality. In many cases an attempt is made in this way to affect the viewer and to in some way change reality through political and social comment, or just by making the viewer stop and stare.

This type of art usually falls into the remit of 'Fine Art', whilst drawing aimed at imaging something and bringing it into being on the page, with a view to later producing that thing generally falls into the 'design' remit. Very broadly, design is seen as of a practical and 'useful' nature, whilst Fine Art drawing is seen as of a creative nature, without a purpose other than the contemplative and entertaining sensation evoked in the viewer of the artwork.

In any case the artist when drawing aims to build a range of mark making skills in order to best express the tone, colour and texture of what they wish to convey. It is a good idea for the beginner artist to build this range by keeping a sketchbook in which to record as many visual experiences as possible – merely noting them through mark making as they arise in day to day life. In this way skills can develop which will be at hand when needed later on in the artist's development.

Finally “Drawing can be defined as an art and design activity that is concerned with visual recording of observations”. “Drawing can also be defined as an original, freehand pictorial representation.” It expresses concepts and feelings in visual term and visually explains complex ideas to other people. It is a method of contact between the artist and the observer. Drawing can be a wonderful tool for creativity. But many of us lack confidence in our ability to draw.

Drawing requires only some basic skills, which we all can acquire. These skills or abilities are:

- Identifying the edges
- Recognizing the spaces
- Calculation of proportions and angles
- Judging light from shadow
- Unconscious skill of pulling it all together.

Objectives:

After studying this unit, you should be able to:

- Describe various concepts of drawing
- Explain elements of drawing
- Explain types of drawings
- Analyze drawing composition

We will now go through various elements and terms related to drawing that are very important for the foundation of any drawing.

2.2 Elements of drawing

Elements are actually the basics of drawing that are very essential to be known. The various elements of drawing are as follows:

1. Point
2. Line
3. Shapes
4. Tone & Shadow
5. Plane
6. Texture
7. Colour
8. Mass
9. Space

These elements are common to all forms of arts such as painting, sculpture, architecture, etc. They are used in combination for giving some meaning to the art form. We will now examine these elements in detail to get a better understanding of these concepts.

1. **Point:**



Figure 2.2: Points

Important element of drawing is a point. A point is where a drawing starts. It is nothing but a dot, and is the simplest of all the elements. Even while writing, we begin with a point. Every drawing begins with a point. It is the most preliminary aspect of any pictorial and graphic representation. Points can be employed in several ways, for instance, they can project expressions.



Figure 2.3: Demonstrating how points can be used to convey an expression

It is the primary mark in the contact of the artist's tool with his surface. A point always conveys a sense of assurance through its fixed position. Points in combination: A repetitive sequence of points can be constructed. This gives the impression of continuity and eye movement is induced in the direction of the sequence and this reflects how points in combination can be applied”.

Points can take up several forms. They are not necessarily restricted to being dots. They can be triangles, squares and other geometrical shapes.



Figure 2.4: Demonstrating how points can come in various forms

The ideal shape of a point is circular. It can be in the form of a square or a triangle, sharp, large or small. Points have aesthetic value. They can be used very effectively in creative art by way of applying shades and tones. Points have a great deal of creative utility.



Figure 2.5: illustration demonstrating how points can be used to give shading and tone, which would also create an interest in the drawing.

Points are also used in drawings to give shadow and shading effects. This method of using points is known as stippling. In the figure 2.5 where you will notice how points have been used to fine-tune some areas by slowly darkening and balancing them with one another. A delicate balance had been found between these areas because if the backgrounds were too dark it would overpower the shadow.

2. **Line:**

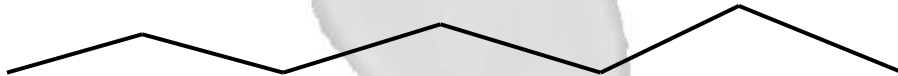
Line is the most basic design 'tool'. A line has length, width, tone, and texture. It may divide space, define a form, describe contour, and suggest direction. Lines are elementary in all sorts of geometric constructions. They have vast applicability and are easy to implement.

Figure 2.6: Line

Although a point is the simplest element to understand, the line is the easiest to follow. Lines are elementary for all visual arts. Drawings is more or less based on the usage of line. The usual meaning of a line is that it represents edge. Line is a thread-like marking as with a pen, pencil, etc. The Swiss artist Paul Klee defined line “as a dot out for walk”.

Different Categories of lines:

Normal Line:

Loose and free lines:**Sharp line:**

Drawing an illustration may have different line weights (thickness), line sizes (lengths), and characteristics. See the illustration given above where different width and lengths are displayed.

Styles of lines: Style is the visual end result of a technique or an application of arts medium.

There are different types of lines like:**- Normal line:****- Dot-dash line:****- Irregular dot-dash line:****- Saw-blade line:**

These types of lines can be used in drawings to create various styles in art. The usage line in a drawing depends on the artist's way of thinking. You can employ these styles according to your interest and liking.

3. Shapes:

Shape occurs when the first line is drawn. The most basic definition of shape is the white area on the paper. Shape is the information that is presented between two or more lines, or is the thing that is enclosed by

line. Shape helps define the object that is depicted as much as the collection of lines that make up the object in the drawing. Incorrect use of shape will cause the drawing to "not look like what it's supposed to be."

Several possibilities exist for creating various shapes. Drawing of shapes can take up vast dimensions ranging from ordinary objects, geographical drawings such as the sun, moon and the solar system to architectural structural like buildings. Shapes have an inner meaning associated with them.

Shape refers to an area of a real or imaginary object that is defined and determined by elements such as value, line, colour, texture and space. A circle, a square and triangle are the three basic shapes in nature. Everything is made up of these three shapes or their variations. We can see circles in faces, the sun and the moon, balls, tires, fruits, vegetables and many more objects. The same goes for the other shapes. Buildings, appliances, computers etc. You can think of many other things, which have shape. Drawing is basically just putting these objects together in a way that makes sense.

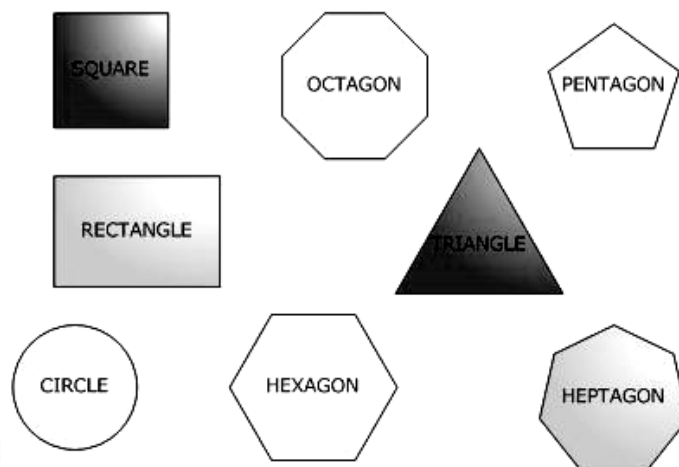


Figure 2.7: Different types of shapes

Each of these shapes has a psychological meaning associated with it. The triangle has an attitude of conflict or action. The circle gives a feeling of protection or infinity. The square is associated with honesty and equality.

4. Tone and Shadow

Shadow and tone are the methods we use to trick the brain into seeing a two-dimensional object as a three-dimensional one. The following examples are a comparison of the same objects prior to shading and after adding some drawing technique. Some other changes such as size and positions were done to create a more interesting display.

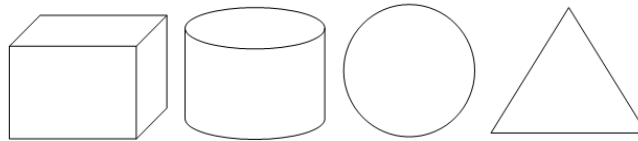


Figure 2.8: Toned shapes

You can see that by adding some tone or shading to an illustration, you can give the objects the illusion of shape. How you render texture, tone and shadow will add much to your drawing ability and make your subject more interesting.



Figure 2.9: Shaded Shapes

5. Plane:



Figure 2.10: Plane

While dabbling with the art of letting, we find ourselves obliged inevitably to shift our attention from stressing on lines to the equally important employment of backgrounds spaces. Such spaces are two-dimensional denoting space that possess height and weight or length and breadth but never depth. They comprise of plane, which has a completely flat surface. Such a surface may be parallel to the observer. It may also be a right angle or diagonal to the observer. Just as a point has position and

line has got direction, a plane has extension because it covers an area in any direction. Say for example. If you are looking at this page, then it is a plane with no depth. A plane has extension because it covers an area in any direction. It may be at a right angle or diagonal to the observer.



Figure 2.11: Graphic display depicting the use of plane in a work of art

Without a plane an artist cannot work. A plane provides the artist with platform for simplifying, organizing and intensifying his or her effects.

6. Texture:

Texture refers to the surface quality of an actual or represented substance. There are two kinds of texture that are stated below.

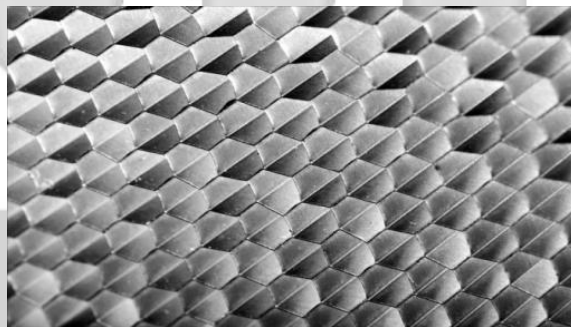


Figure 2.12: Texture

Texture describes the tactile quality of a form. Accurate rendering of an object's texture is the key to very realistic (particularly 'photo-realistic') drawing. The textures of some objects can be particularly challenging

due to movement (water), fine detail (skin surface and hair, grass, leaves) or their ethereal quality (cloud, glass). The texture in a drawing is also a product of the support, such as paper or canvas. Some papers, particularly those for pastel and watercolour, have a textured surface due to the fibres or the mould used to make the paper. Different mediums will show up the inherent texture in the paper.

Types of Texture:

- **Tactile texture:** Means touch. It refers to the actual (3D) feel of a surface.
- **Visual illusion:** Visual texture refers to the illusion of the surface's texture. It is what tactile texture looks like on a 2D surface. All surface have textures. Texture make an image richer and more interesting.

7. Colour:

Colour is simply light of different wavelengths and frequencies and light is just one form of energy that we can actually see that is made up from photons. We are all surrounded by electromagnetic waves of energy of which colour is just a small part. Colour is the by-product of the spectrum of light, as it is reflected or absorbed, as received by the human eye and processed by the human brain. It's also a great design element!

Here's a surface level overview of how it all works:

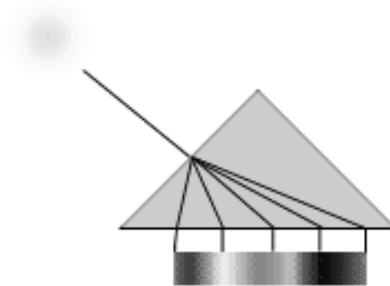


Figure 2.13: Colour

The world is full of light. Visible light is made of seven wavelength groups. These are the colours you see in a rainbow: red, orange, yellow, green, blue, indigo, and violet – the Mr. ROY G. BIV you might have been introduced to in elementary school science. The reddish colours are the long wavelengths. The greenish colours are the mid-size

wavelengths. The bluish colour is the short wavelengths. When light hits objects, some of the wavelengths are absorbed and some are reflected, depending on the materials in the object. The reflected wavelengths are what we perceive as the object's colour.

Our eyes are the input channels, if you will, for this light. One portion of the eye is called the retina and it contains four types of light sensors. First are the rods, which record brightness and darkness and from which we "see" a sort of coarse sketch of the world. Next are three types of cones, each one optimized to absorb a different spectrum range of visible light. One set of cones absorbs long wavelengths, the reds. Another absorbs mid-size wavelengths, the greens. The third absorbs short wavelengths, the blues. Together, these rods and cones gather the information that our brain then processes into one combined image.

What this all means for the designer is that colour is a function of light and biology – which means that no two people see colour exactly the same. It also means that reproduced colour can be described, defined, and modelled through a variety of mathematical and visual lenses called colour spaces. Combine these two factors and you can quickly see how colour – and its theory and use – can quickly take on the tone of a religious war.

8. **Mass:**

“Mass refers to substance and matter and can be a powerful visual tool”. Painting and graphics arts are only two-dimensional, possessing height and width, while other visual arts are three-dimensional, having depth as well. They utilise an element which painting can possess only by illusion i.e. the element of mass, which consists in the bulk or quantity of matter.

Mass refers to the size or amount of space taken up by an element. Mass is imagined as composing the essence of the earth and the various forms on its surface. Our own bodies are regarded as masses. We recognize the universal pull of gravity, which gives us weight, and derive great satisfaction in the physical power with which we resist the pull of gravity and hold ourselves erect. This sort of experience is projected into other masses and thought of as corresponding to a yielding resisting relationship with the earth.

9. Space

We are prone to ignore space as mere surplus room left over after material substance has occupied what it want. But space in which to live, move about, and breathe is just as important as living matter itself, and open space that has the potential of being occupied, must be considered as another kind of volume, important to art, as it is to life.

Space fits into any 3-D work as, in the form of negative area entering the structure of a 2-D work and any space not occupied by mass should be regarded in a like manner as a negative space. Space stretches in the tension between one line and another. The surface of your drawing contains a distinction between shapes in the form of positive and negative space. Positive space refers to the shape of the object drawn. Negative space describes the area surrounding the positive shapes.

Our eyes are trained to seek out positive shapes such as recognizing a chair or a coffee cup. In order to successfully master the skill of drawing, an artist has to get rid of this habit, and look not only at positive shapes, but the negative space that surrounds them. All shapes both positive and negative, are equally important. Together, they provide a composition with unity.

Two-dimension design is concerned with the flat space that the design takes place on and relates to the illusion of three-dimensional space. The major methods of controlling the illusion of space are as follows:

Overlap: It signifies space whereby objects are located in front of one another.

Shading: This signifies space whereby modelling is done with light and dark shades.

Linear perspective: This implies the relationship between apparent size and space.

Atmospheric perspective: This demonstrates how atmosphere affects the appearance of objects in space.

The following example can clarify the terms of positive and negative space;

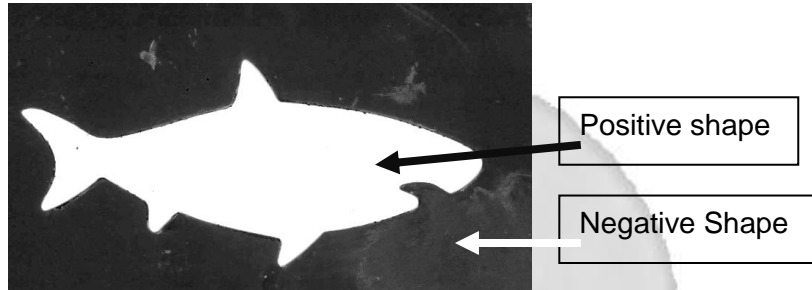


Figure 2.14: Showing Positive and Negative shape

Positive shape is the shape inside the outline while negative shape is the area outside it.

In the above drawing, the two objects are joined to create a composite shape (a single form). The two objects are overlapped in one or more areas to achieve enclosed positive and negative shapes. Now after understanding about the different elements of drawing, let us know the ways of creating drawing.

2.3 Creating Drawing

Drawing as always been the essence of most art forms. Since the beginnings of mankind it has always been the closest form to nature. It is another form of language to express nature, creativity, (creativity which comes from nature and what we see) and mankind.

Drawing is the act of creating a representation of any subject by the use of lines and/or value. Most people associate drawing with pencils or charcoal, but a drawing can be made with any instrument that makes a mark. When some mediums are used to create a piece of art, the result is always considered a "drawing". Charcoal and graphite pencil are examples of these. Other mediums can be drawn "with" but the resulting artwork may or may not be considered a drawing. For example, art created with a computer can be either drawn or painted.

Drawing is considered to be the foundation of all other visual art forms. Drawing students learn how to observe line, form, texture, and value and then reproduce them realistically. Once these basic skills are mastered, they can be utilized in any other visual art medium.

While imaginative or fantasy drawing is creative, realistic drawing is the best way to learn basic art skills and even very young students can learn to draw in a realistic way if they are taught how. Most children and most adults too, feel a profound sense of accomplishment when they draw any subject accurately. The skill required to draw realistically makes drawing from the imagination even more rewarding, too. It's easier to draw the dragon you see in your mind if you know how to draw scales and flames!

2.4 Types of drawing

As the written word is essential to the poet and writer, and the algorithmic formula is imperative to the mathematician, drawing is the essence of the artist and designer's expression. As an effective means of communication and thinking, drawing operates on many levels, and it is important for the artist and designer to not only comprehend these differences, but to also achieve a certain level of skill in the discipline of drawing. Drawing can be a tremendously empowering tool for communication and thinking. This article will briefly explore and loosely define the many different approaches, or types, of drawing.

Drawing methodologies and their respective purposes, apparent are at least eight distinct categories, including:

1. **Life Drawing:** drawing as a means of expression; drawing from direct observation, as in still-life or figure drawing.



Figure 2.15: Life Drawing

2. **Emotion Drawing:** drawing, like painting, as an expressive way to explore and put forth feeling, mood, self, time, and so on; drawing as a sensitive expression of personality.



Figure 2.16: Emotion Drawing

3. **Sketching:** drawing in order to explain or actively think through a problem; drawing through the act of visualizing; drawing actively and loosely.



Figure 2.17: Sketch Drawing

4. **Analytic Drawing:** drawing as a way to dissect, understand and represent; drawing from observation.

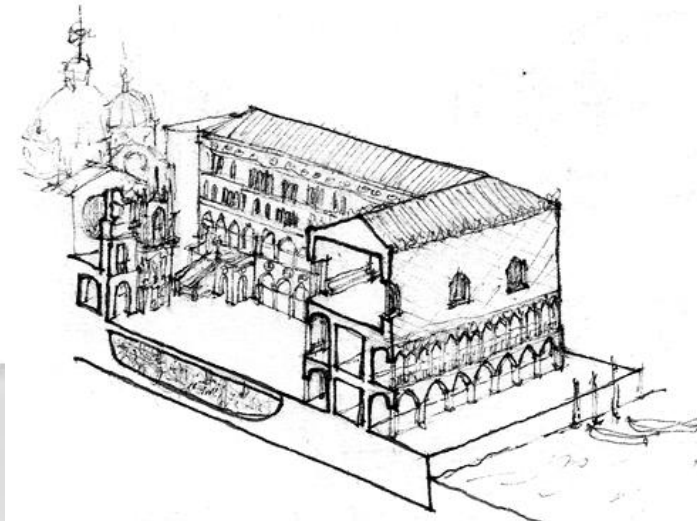


Figure 2.18: Analytic Drawing

5. **Perspective Drawing:** drawing as a way to represent volume, space, light, eye-level (horizon), surface planes, and scale.

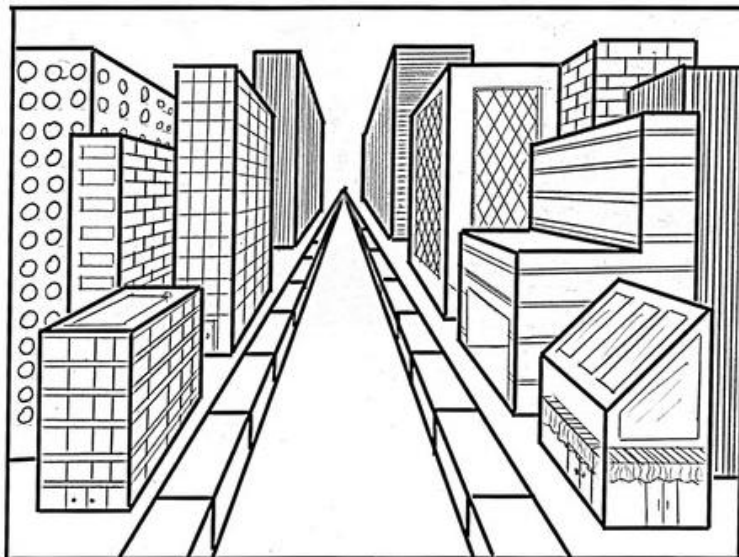


Figure 2.19: Perspective Drawing

6. **Geometric Drawing:** drawing as a means to precisely represent all

aspects of construction; drawing that shows measured scale, true sides, sections, and a variety of descriptive views.

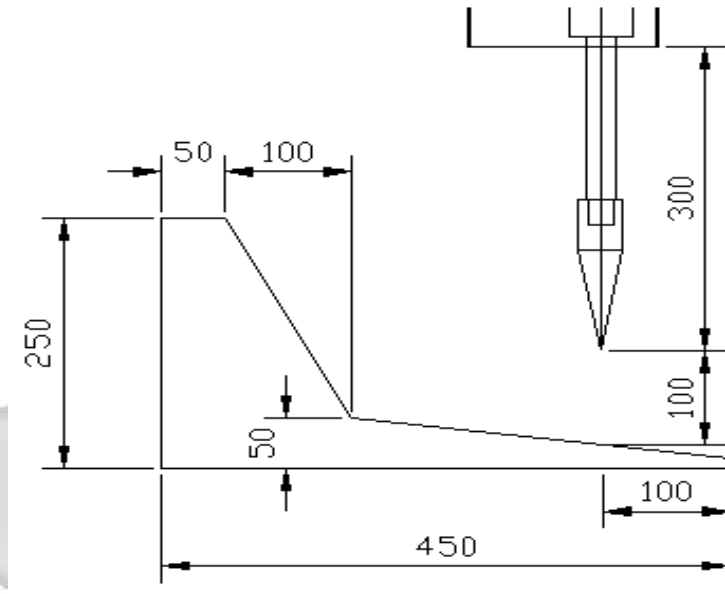


Figure 2.20: Geometric Drawing

7. **Diagrammatic Drawing:** drawing in order to investigate, explore, and document concepts and ideas; drawing as an active design process where ideas evolve due to adjacencies and happenstance.

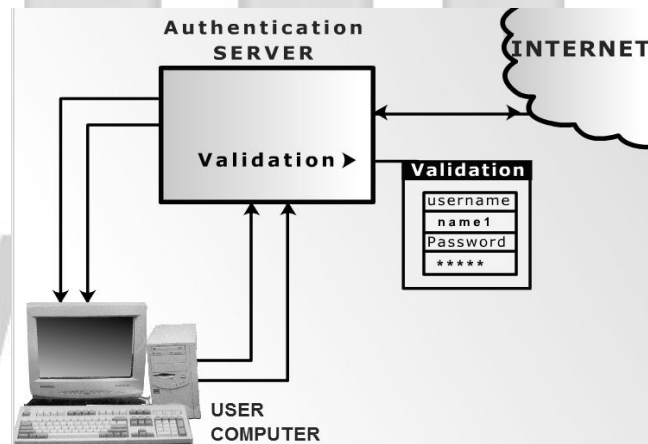


Figure 2.21: Diagrammatic Drawing

8. **Illustration Drawing:** drawing in order to document; drawing to clearly state and render intent, style, size, colour, character, effect, and so on.



Figure 2.22: Illustration Drawing

The marks made for each of these drawing categories vary greatly, as do the materials, tools, techniques, and even substrates on which the drawing is produced. A graphite pencil makes a different mark than a marker, than a vine charcoal stick, than a ballpoint pen, and on and on. Newsprint paper is appropriate for some drawing materials, such as pencil, charcoal and crayon, whereas more wet mediums, such as markers or India ink may prove problematic.

Concurrently, the purpose for each of these drawings categories vary, as do the end result. A sketch can quickly document an idea upon first conception, whereas a geometric drawing requires a much longer gestational period. The sketch is of the moment and the geometric drawing is more labored. The sketch contains possibility and potential, whereas the geometric drawing is more like the ending chapter to a novel, final.

The person who makes the drawing must weigh the truth and consequences of the effort, choose the method of drawing that is appropriate, that which will provides the best result.

This is not to say that the act of drawing should not be experimental in nature. To the contrary, investigation is paramount to the creative process and the educational process.

Practice drawing, experience using drawing, and exposure to comparative examples of drawing provide one with a greater ability to make choices regarding the appropriate drawing technique, material, surface, tool and approach to utilize when beginning a drawing.

Where words and formulas cannot quite describe the creative intent, drawing succeeds in being a tremendously empowering tool for communication and thinking. The artist and designer are much stronger in her ability to create with this skill mastered.

2.5 Drawing Composition

The terms composition in art refer to the design and planning and/or arrangement of form and/or colour, in two or three-dimensional work. Design/composition is one of the "formal" elements used in art, along with space, colour, tone (lights and darks), and other elements. An arrangement of placing or putting design elements together is called composition. Composition creates illusion of depth, space and adds interest to the drawing.

2.5.1 Depth Cues:

Depth cues are a very important concept of drawing composition. 3D objects must be represented on flat surfaces. To help us visualize and represent the depth of an object, we need to utilize depth perception cues in our drawings" Depth cues give the illusion of depth in a drawing. Some of the perceptual cues that give rise to the impression of depth include:

- 1) Interposition
- 2) Relative Height
- 3) Relative Size
- 4) Texture Gradient

1) Interposition

Interposition is the partial blocking of a more distant object by a nearer object, In figure 2.23 given below "the two triangles appear at different depths because one is partially hidden by the other. Actually, both

triangles are at the same distance (the distance of the screen from your eyes)" Interposition (overlap, occlusion or superposition) causes the sense of depth to arise. The example given below shows that three shapes are actually at similar distance but due to interposition they seems to appear at different depths.

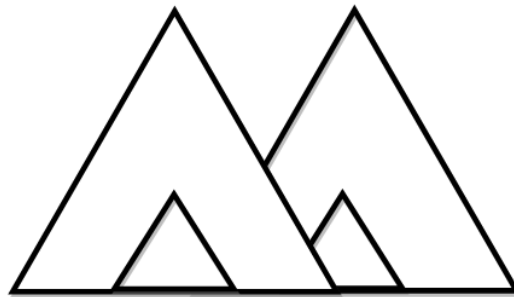


Figure 2.23-A: Demonstrating Interposition

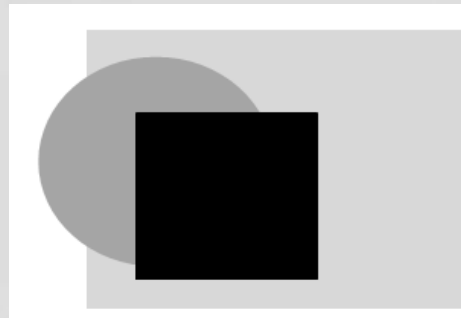


Figure 2.23-B: Demonstrating Interposition

2) Relative Height

Another pictorial cue to depth is the relative height of objects in the drawing. An object close to the viewer will be at the bottom of the drawing, an object at a distance will be near the middle of the drawing, and objects will be ever higher as they are more distant. This cue can lead to a powerful sense of depth.

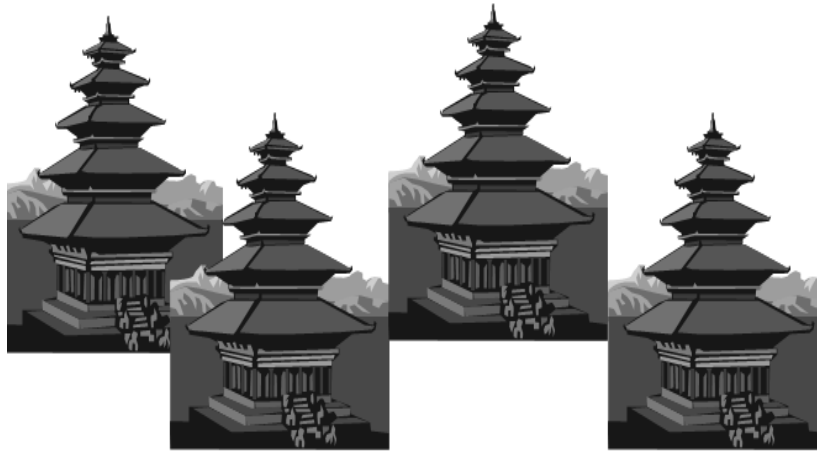
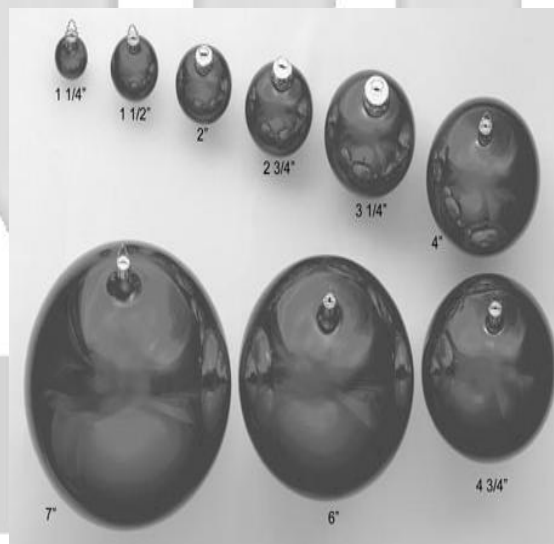


Figure 2.24: Relative height can be powerful pictorial cue for depth

3) Relative Size

Another pictorial cue to depth is the relative size of objects in the drawing. Objects are drawn smaller as they move further away from the viewer. In the example given below, note how the objects are sized so as to create an illusion that the objects are away from each other.



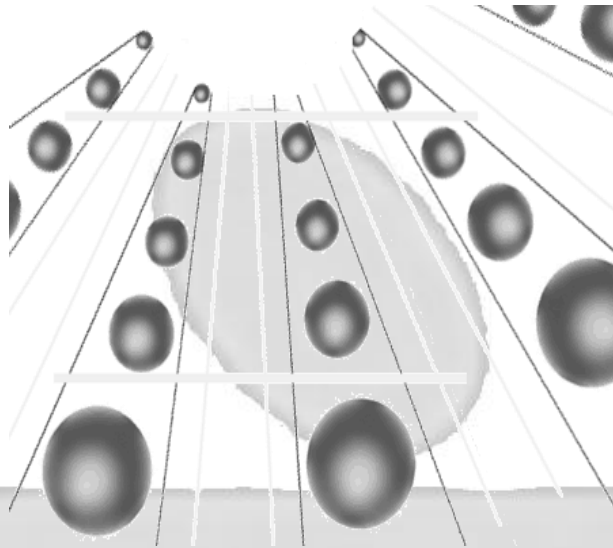


Figure 2.25: Examples of displaying relative size

4) **Texture Gradient**

Most surfaces, such as walls and roads, and fields, like a field of flowers in bloom, have a texture. As the surface gets farther away from us, this texture gets finer and appears smoother. The figure below attempts to illustrate texture gradient using circles. At each level, as the circles get smaller, we get the impression that the circles are moving farther away.

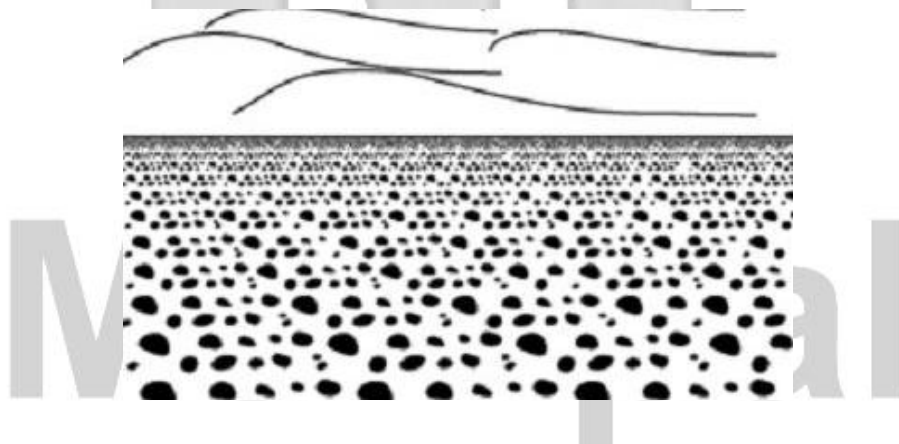


Figure 2.26: Texture Gradient

2.6 Perspective Drawings

Perspective drawing is a drawing technique used to portray objects in 3 dimensions or 3D. The perspective drawing method is commonly used for drawing buildings and other such structures in 3 dimensions so that it shows greater detail. Discovered centuries ago, perspective drawing can still add a great deal of value and detail to your presentations. However it is imperative that you obtain the services of a professional perspective drawing person in order to ensure that a proper accurate job is done.

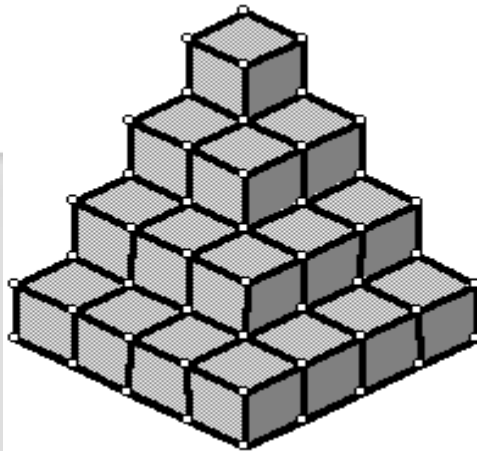


Figure 2.27: Perspective Drawings

Perspective drawing is used in many different fields. Engineers or industrial design engineers will draw using an isometric grid to give a fixed perspective. They may draw the different parts or draw an entire building.

There are three types of perspective:

- 1) One-point
 - 2) Two-point
 - 3) Three-point
- 1) **One-point perspective:** occurs when the projection plane is parallel to two principal axes. Conversely, when the projection plane is perpendicular to one of the principal axes, one-point perspective occurs. Receding lines along one of the principal axes converge to a vanishing point. A one-point perspective is used almost exclusively for interior room previews. It gives the observer the illusion of looking into the room.

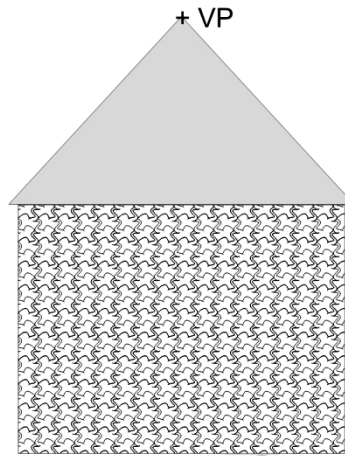


Figure 2.28: One-point perspective Drawing

- 2) **Two-Point:** perspective is a *two-point* perspective. It is often used for architectural renderings. If the projection plane is parallel to one of the principal axes or if the projection plane intersects exactly with two principal axes, a two-point perspective projection occurs. In this perspective, the visual rays are not parallel and converge at two vanishing points.

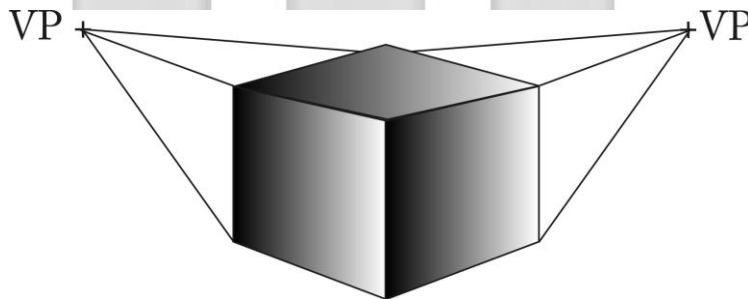


Figure 2.29: Two-point perspective Drawing

- 3) **Three-point:** If the projection plane is not parallel to any of the principal axis, a three-point projection occurs with the visual rays converging to three vanishing points.

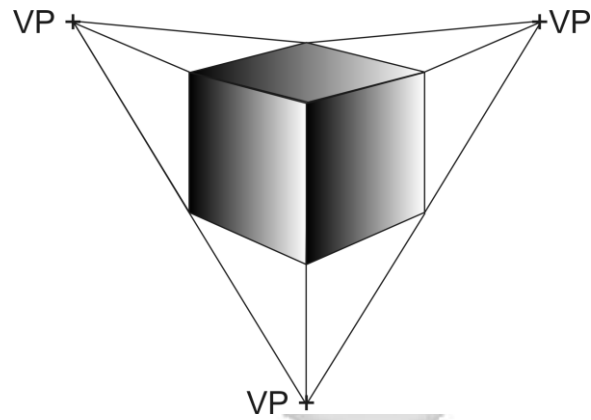


Figure 2.30: Three Point Perspective

The vertical lines also converge at a vanishing point.

2.7 Multi View Drawing

A "Multiview Drawing" shows the shape of an object from two or more directions. Each view is arranged at a 90° angle to the adjacent view and provides the "True Shape" of horizontal or vertical surfaces. The main purpose is to obtain views of an object on which true measurements can be made. Therefore, the front face is oriented parallel to the projection plane so that the established view shows the true width and height of the object.

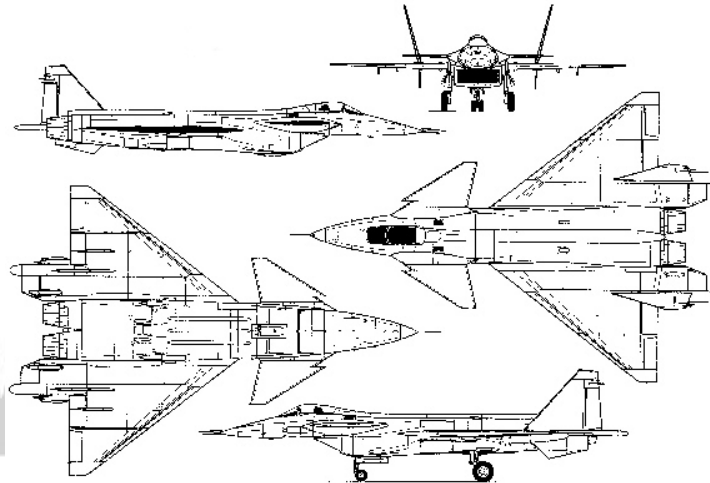


Figure 2.31: Multi-view Drawing

A surface that appears in its true shape in one view will appear as a line or an "Edge View" in an adjacent view. This relationship of views arranged at 90° to each other is called "Orthographic Projection". Basically, this means that a line, corner, edge or surface in one view should "line up" or "project" to a line, corner, edge or surface in the adjacent view.

2.8 Diagrams

A diagram is the systematic graphic representation of different subject. A diagram may be defined as a graphic representation of an assembly or system that indicates the various parts and expresses the methods or principles of operations.

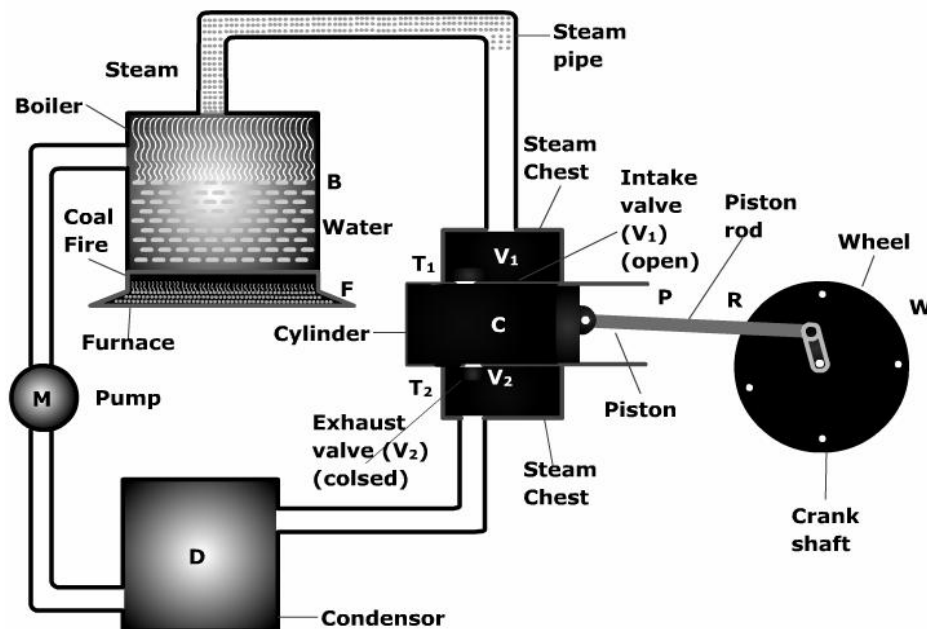


Figure 2.32: Diagram representing various parts of Steam Engine

2.9 Presentation Drawings

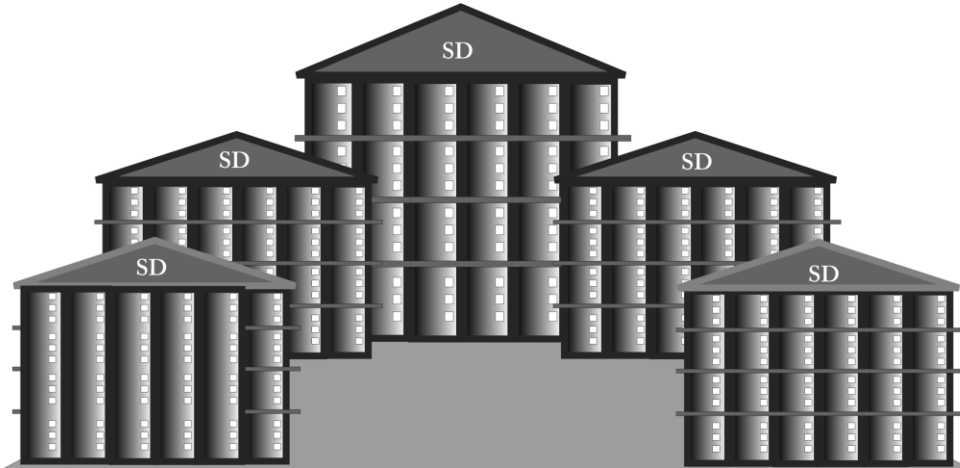


Figure 2.33: Presentation Drawings

"Presentation Sketch or Drawing" is used to illustrate and communicate the designer or architect's solution to the client's design problem. Presentation drawings show the proposed building or facility in an attractive setting in its natural surroundings at the proposed site.

Since presentation drawings are actually used to sell an idea or a design, you only contact with such drawings will be as a cover sheet for a set of construction drawings. "Presentation Sketches or Drawings" are usually prepared on illustration board, vellum, sketching or bond papers. Hatching, shading and rendering techniques along with coloured pencils, inks or markers may also be used to portray a more realistic appearance.

Self Assessment Questions (MCQ's)

1. Important element of drawing is a _____
2. A line is a combination of _____
3. _____ refers to the surface quality of an actual or represented substance.
4. _____ is simply light of different wavelengths and frequencies and light is just one form of energy that we can actually see that is made up from photons.
5. The terms _____ in art refer to the design and planning and/or arrangement of form and/or colour, in two or three-dimensional work.

6. _____ drawing is used to illustrate and communicate the designer or architect's solution to the client's design problem.

2.10 Summary

- Drawing has a number of primary functions that differ according to the intended outcome.
- Drawing is sometimes used as a preparation for a painting, either as an observational sketchbook exercise or as a preliminary to painting upon canvas, as a means of mapping out where different areas of colour will go.
- The principle aim of drawing is to record events, images or ideas using the friction between the drawing implement and the draw-upon surface to leave a mark that can be referred to in the future for reference or entertainment.
- The various elements of drawing are: Point, Line, Shapes, Tone, Shadow, Plane, Texture, Colour, Mass and Space.
- Various types of drawings are: Life Drawing, Emotion Drawing, Sketching, Analytic Drawing, Perspective Drawing, Geometric Drawing, and Diagrammatic Drawing & Illustration Drawing.
- The terms composition in art refer to the design and planning and/or arrangement of form and/or colour, in two or three-dimensional work.
- Perspective drawing is a drawing technique used to portray objects in 3 dimensions or 3D.
- A "Multiview Drawing" shows the shape of an object from two or more directions.
- A diagram is the systematic graphic representation of different subject.

2.11 Terminal Questions

1. How do you define the drawing?
2. Briefly explain elements of drawings.
3. What is the role of drawings in day to day life?
4. What are perspective drawings?

2.12 Answer**Self Assessment Questions**

1. Point
2. Length, width, tone, and texture
3. Texture
4. Colour
5. Composition
6. Presentation Sketch

Terminal Questions

1. Drawing has a number of primary functions that differ according to the intended outcome. (Refer section 2.1)
2. Elements are actually the basics of drawing that are very essential to be known. (Refer section 2.2)
3. Drawing has always been the essence of most art forms. Since the beginnings of mankind it has always been the closest form to nature. (Refer section 2.4 and 2.5)
4. Drawing as a way to represent volume, space, light, eye-level (horizon), surface planes, and scale. (Refer section 2.5)



Manipal

Unit 3

Concepts of Colours

Structure

- 3.0 Introduction
 - Objectives
- 3.1 What Is Colour?
- 3.2 Characteristics of colour
- 3.3 The colour wheel
- 3.4 Primary colours
- 3.5 Secondary Colours
- 3.6 Analogous Colours
- 3.7 Complementary Colours
- 3.8 Black and White
- 3.9 Tertiary Colours
- 3.10 Warm Colours
- 3.11 Cool Colours:
- 3.12 Hue, Saturation and Value
- 3.13 Tint, Shade and Tone
- 3.14 Transparent, Opaque and Colour Harmony
- 3.15 Colour modes and models
 - 3.15.1 HSB model
 - 3.15.2 RGB model
 - 3.15.3 CMYK model
 - 3.15.4 L*a*b model
 - 3.15.5 Lab model
 - 3.15.6 Bitmap mode
 - 3.15.7 Gray-scale mode
- 3.16 Summary
- 3.17 Terminal Questions
- 3.18 Answers

3.0 Introduction

Colour is the perceptual characteristic of light described by a colour name. Specifically, colour is light, and light is composed of many colours those we see are the colours of the visual spectrum: red, orange, yellow, green, blue,

and violet. Objects absorb certain wavelengths and reflect others back to the viewer. We perceive these wavelengths as colour.

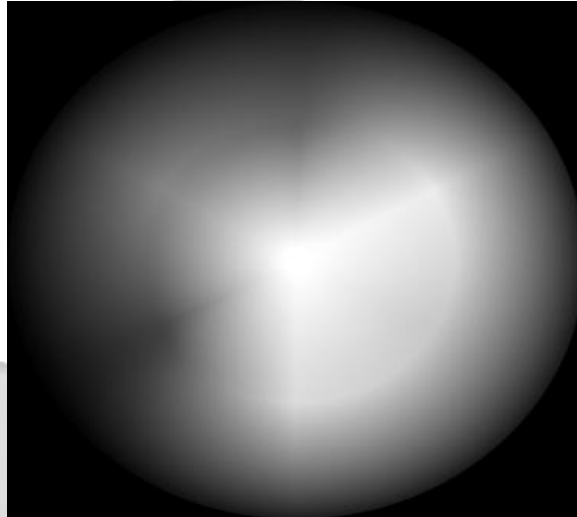


Figure 3.1: Colours

A colour is described in three ways: by its name, how pure or desaturated it is, and its value or lightness. Although pink, crimson, and brick are all variations of the colour red, each hue is distinct and differentiated by its chroma, saturation, intensity, and value.

Chroma: intensity, saturation and luminance/value are inter-related terms and have to do with the description of a colour.

Chroma: How pure a hue is in relation to Gray?

Saturation: The degree of purity of a hue.

Intensity: The brightness or dullness of a hue. One may lower the intensity by adding white or black.

Luminance / Value: A measure of the amount of light reflected from a hue. Those hues with a high content of white have a higher luminance or value.

Shade and tint are terms that refer to a variation of a hue.

Shade: A hue produced by the addition of black.

Tint: A hue produced by the addition of white.

Colours affect us in numerous ways, both mentally and physically. A strong red colour has been shown to raise the blood pressure, while a blue colour has a calming effect. Being able to use colours consciously and harmoniously can help you create spectacular results.

Objectives:**After studying this unit, you should be able to:**

- Describe concepts of Colour
- Explain Characteristics of drawing
- Explain colour wheel
- Analyze Colour modes and models

3.1 What is Colour?

Colour is the by-product of the spectrum of light, as it is reflected or absorbed, as received by the human eye and processed by the human brain. It's also a great design element!

Here's a surface level overview of how it all works:

The world is full of light. Visible light is made of seven wavelength groups. These are the colours you see in a rainbow: red, orange, yellow, green, blue, indigo, and violet – the Mr. ROY G. BIV you might have been introduced to in elementary school science. The reddish colours are the long wavelengths. The greenish colours are the mid-size wavelengths. The bluish colours are the short wavelengths.

When light hits objects, some of the wavelengths are absorbed and some are reflected, depending on the materials in the object. The reflected wavelengths are what we perceive as the object's colour.

Our eyes are the input channels, if you will, for this light. One portion of the eye is called the retina and it contains four types of light sensors. First are the rods, which record brightness and darkness and from which we "see" a sort of coarse sketch of the world. Next are three types of cones, each one optimized to absorb a different spectrum range of visible light. One set of cones absorbs long wavelengths, the reds. Another absorbs mid-size wavelengths, the greens. The third absorbs short wavelengths, the blues. Together, these rods and cones gather the information that our brain then processes into one combined image.

What this all means for the designer is that colour is a function of light and biology – which means that no two people see colour exactly the same. It also means that reproduced colour can be described, defined, and modelled through a variety of mathematical and visual lenses called *colour spaces*. Combine these two factors and you can quickly see how colour – and its theory and use – can quickly take on the tone of a religious war.

The goal is to understand that colour isn't an exact science and your job is to use it in the best way for your specific application.

3.2 Characteristics of colour

There is a great relationship between colours and human nature. One's mood changes according to the colour of the clothing that one wears. The influence of colour on human life is very interesting.

Blue is the coolest color - the color of the sky, ocean, sleep, twilight. The ancient Egyptians used lapis lazuli to represent heaven. Blue symbolizes the Virgin Mary. A pure blue is the color of inspiration, sincerity and spirituality. Blue is often the chosen color by conservative people. Blue is the calming color. That makes it a wonderful color to use in the home, especially for babies. Blue is so soothing that is a good choice for pajamas.

Dark blue is the colour of truth and moderation. A blue iris means your friendship is very important to me. Wednesday's colour is blue. Blue gemstones to wear to feel calm are blue sapphire and blue topaz. Lapis lazuli and azurite are said to heighten psychic power.

Red: "Red is known as a passionate and powerful color. It can alert and excite the senses and this quality is used for various signboards, for example, a traffic signal indicating 'stop'." Red is the warmest of all colors. Red is the color most chosen by extroverts and one of the top picks of males. On the negative side red can mean temper or anger. In China, red is the color of prosperity and joy. Brides wear red and front doors are often painted red. Red is Tuesday's color. Red roses symbolize passionate love. Ruby rings should be worn on the left hand. Red is the color of Mars. This planet is known as the God of War.

Black: is the most misunderstood color. A black tie dinner is very formal and elegant. Women can wear that "must have little black dress" to the black tie dinner. Yet the bad guys wear black hats. Black symbolizes death in some

cultures. Native Americans thought black was good because it was the color of soil, which gives life. Saturday's color is black.

In times of fear and uncertainty black contains the energy of the threatening unknown. In a positive state, black is seen as a restful emptiness into which anything may emerge and disappear once again. It is also mysterious, providing a sense of potential and possibility.

Color White - White is the color of purity. Brides wear white in many countries, because white symbolizes a virgin. White means kindness. In some cultures white is worn at funerals. White is Monday's color. White daisies are a symbol of loyal love.

White has purification vibrations and can be used to clear blocks from your path.

It holds the potential to move toward every other color and this makes it a good choice for new beginnings, and development in any direction.

Color Green - Green is the color of nature, fertility and life. Grass green is the most restful color. Green symbolizes self-respect and well being. Green is the color of balance. It also means learning, growth and harmony. Green is a safe color, if you don't know what color to use anywhere use green.

Green is favored by well balanced people. Green symbolizes the master healer and the life force. It often symbolizes money. It was believed green was healing for the eyes. Egyptians wore green eyeliner. Green eyeshades are still used. You should eat raw green foods for good health. Friday is the day of green. Green jade is a sacred stone of Asia.

Color Yellow - The shade of yellow determines the meaning. Pure, bright and sunny yellow is the easiest color to see. People who are blind to other colors can usually see yellow. Yellow is full of creative and intellectual energy. Always use yellow note pads. Yellow symbolizes wisdom. Yellow means joy and happiness. People of high intellect favor yellow. Yellow daffodils are a symbol of unrequited love. Sunday's color is yellow-gold.

3.3 The colour wheel

Everything you ever wanted to know about colour is indicated in the colour wheel. It signifies the relationship of colours with each other and presents the primary, secondary and complementary colours.

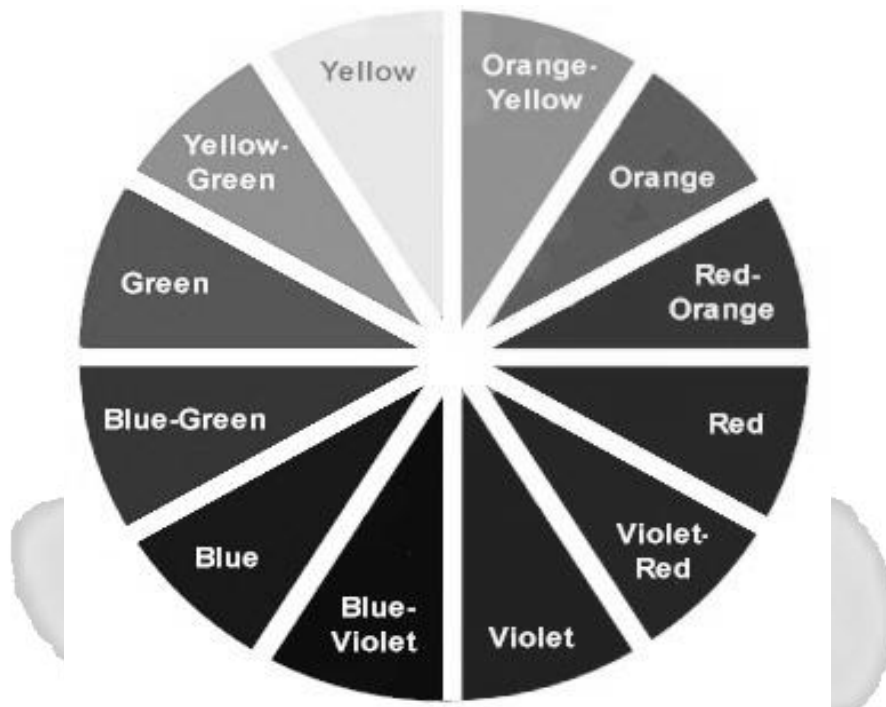


Figure 3.2: Colour wheel indicating a wide spectrum of colours

Understanding the colour wheel is the primary thing for exploring the universe of colours. The colour wheel is a simple device for understanding colours in relation to one another. A colour circle, based on red, yellow and blue is traditional in the field of art. Sir Isaac Newton developed the first circular diagram of colours in 1666. Since then scientist and artist have studied and designed numerous variations of this concepts. There are various classifications such as secondary colours that can be obtained by mixing primary colours. Complementary colours warm/cool colours can be appreciated by just having a glance at the colour wheel.

3.4 Primary colours

In fine arts, there are three primary colours: red, blue, and yellow. They are called primary colours because they cannot be created by mixing other colours. Primary colours form the basis for colour theory or colour mixing, as using these three colours it's possible to mix most other colours.

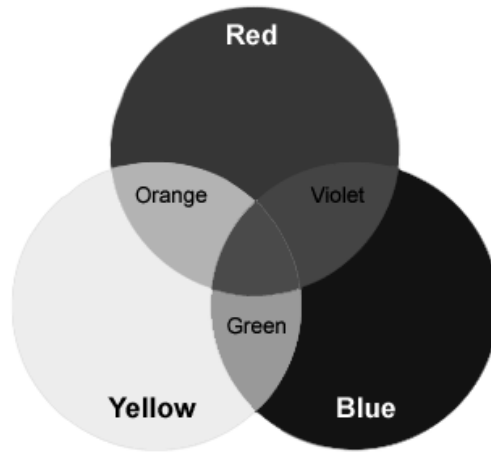


Figure 3.3: Primary Colours

Primary colour can be any of the red, blue, or yellow pigments available to a painter. Each combination will give you a different result, and that's part of what makes colour mixing with paints so interesting. You can also use the primaries used in printing (magazines, newspapers etc.) which are magenta, cyan, and yellow (plus black), but limiting yourself to these means you never explore the rich potential of paint colour mixing and the subtle differences between pigments.

3.5 Secondary Colours

A secondary colour is a colour made by mixing two primary colours together: red and yellow to get orange, yellow and blue to get green, or red and blue to get purple. The secondary colour depends on the proportion in which you mix the two primaries.

- **orange = red + yellow**
- **green = yellow + blue**
- **violet = blue + red**

Figure 3.4: Secondary Colours

For example, if you add more red than yellow, you get a reddish orange, and if you add more yellow than red, you get a yellowish orange.

3.6 Analogous Colours

Analogous colours or related colours are that nearly like one another and close together on the colour wheel. Such a colours scheme formulates unity. For example, if yellow is taken as a main, dominant colours, then green, orange, yellow and light green are its related colours, because yellow is included in all of them.

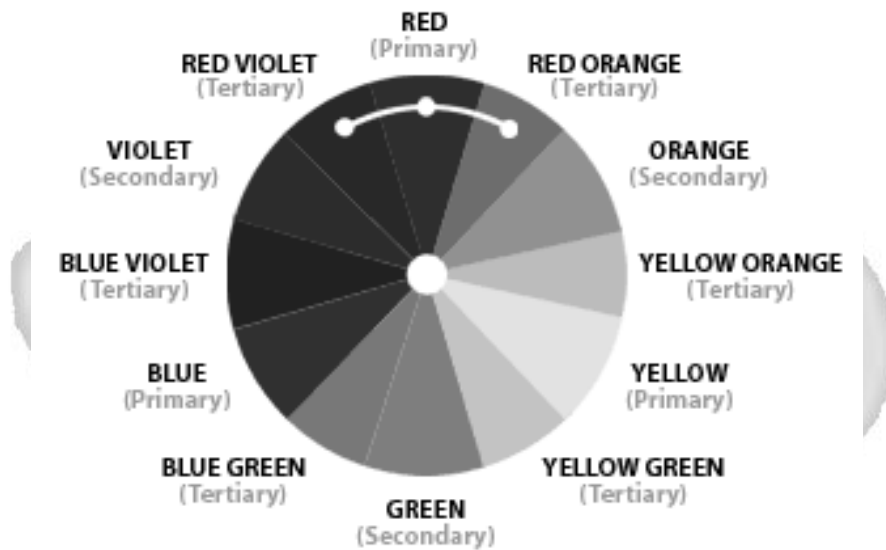


Figure 3.5: Analogous Colours

3.7 Complementary Colours

Two colours on opposite sides of the colour wheel, when placed next to each other make both appear brighter. The complementary colour of a primary colour (red, blue, and yellow) is the colour you get by mixing the other two (red + blue = purple; blue + yellow = green; red + yellow = orange). So the complementary colour for red is green, for blue it's orange, and for yellow it's purple.

We look at a colour wheel to understand the relationships between colours. Analogous colours are positioned in such a way as to mimic the process that occurs when blending hues. The colours that are positioned opposite one another are complementary colours.

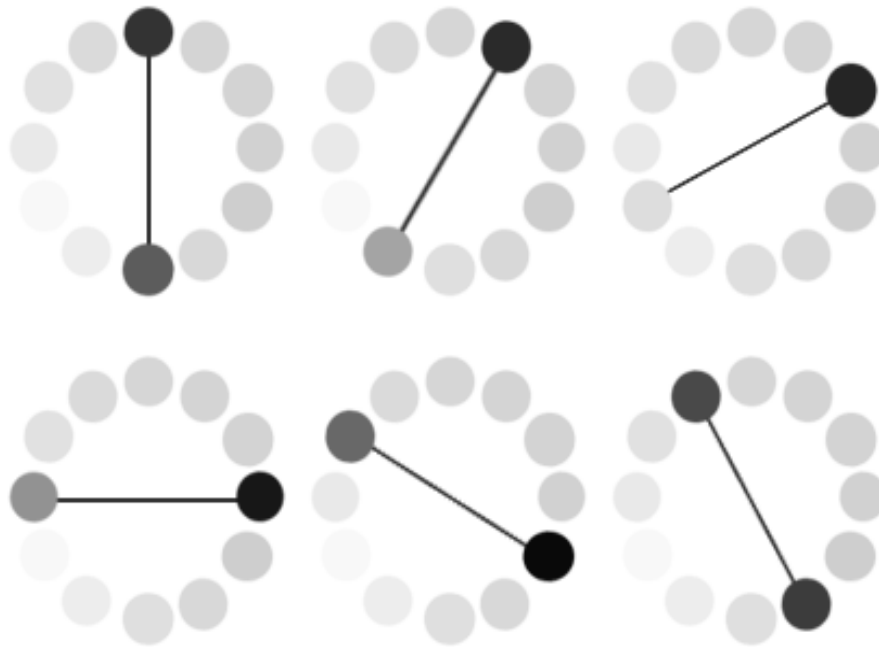


Figure 3.6: Displaying Complementary Colours

To call those hues in direct opposition to each other "complements of each other" is appropriate. Complementary colours bring out the best in each other. When fully saturated complements are brought together, interesting effects are noticeable. This may be a desirable illusion, or a problem if creating visuals that are to be read.

3.8 Black and White

These are not regarded as colours. White indicates light while black denotes the absence of light. However, in daily practice, they are referred to as white and black colours for the sake of convenience.

3.9 Tertiary Colours

Tertiary colours are obtained by mixing a Primary and a Secondary colour together.

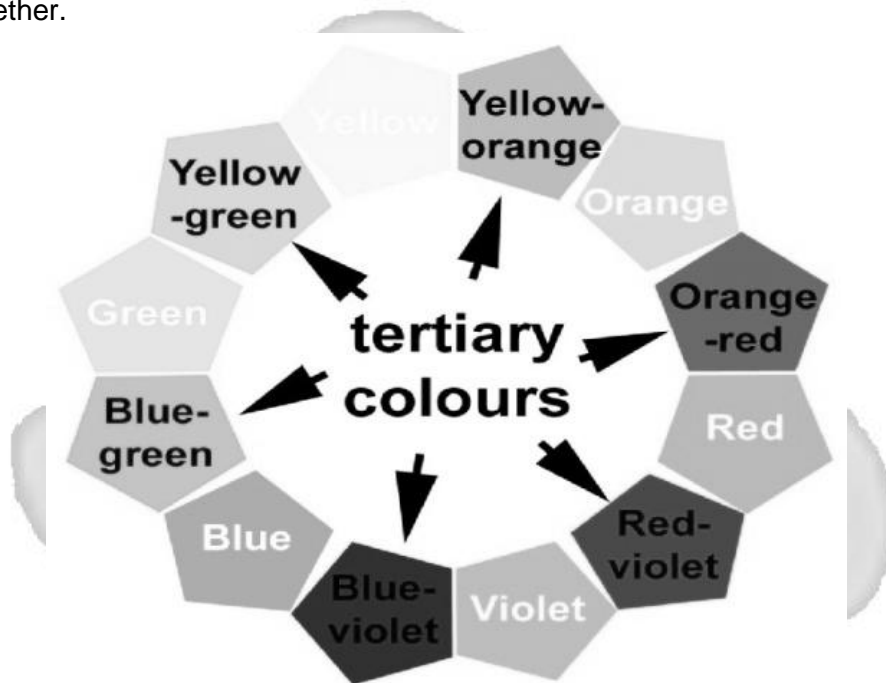


Figure 3.7: Tertiary Colours

There are six tertiary colours: Yellow-orange, Orange-red, Red-violet (orchid), Blue-violet, Blue-green & Yellow-green (lime).

If any two secondary colours are mixed together in equal proportion, then we generally obtain a third grade colour also referred to as the tertiary colour. While preparing tertiary colours, the primary or original colours that happen to be there in greater proportion are dominantly seen in the mixture or tertiary. For example, yellow is the primary colour existing in both, green and orange and consequently the mixture becomes yellowish gray.

3.10 Warm Colours

Red, Orange and some Yellows and Purples are considered to be **warm** colours. Red is our psychologically dominant warm colour, a symbol of fire

and heat! People who are extroverts tend to prefer warm hues. Warm colours advance in a painting.

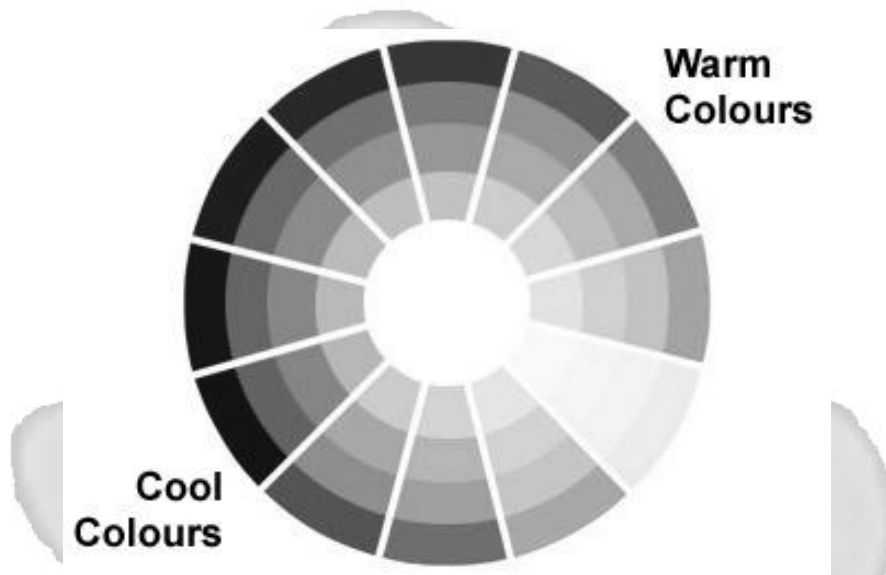


Figure 3.8: Warm Colours

3.11 Cool Colours

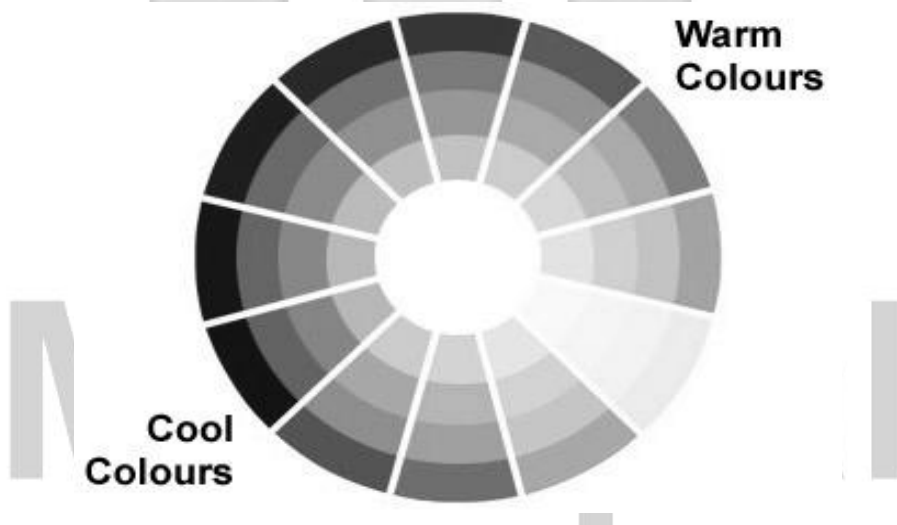


Figure 3.9: Cool Colours

Cool colours tend to have a calming effect. At one end of the spectrum they are cold, impersonal, antiseptic colours. At the other end the cool colours are comforting and nurturing. Blue, green, and the neutrals white, gray, and silver are examples of cool colours.

In nature blue is water and green is plant life – a natural, life-sustaining duo. Combine blues and greens for natural, watery colour palettes. Heat up a too cool colour palette with a dash of warm colours such as red or orange. If you want warmth with just a blue palette, choose deeper blues with a touch of red but not quite purple or almost black deep navy blues.

Cool colours appear smaller than warm colours and they visually recede on the page so red can visually overpower and stand out over blue even if used in equal amounts. The profiles for each of these cool colours include descriptions of their nature; cultural colour meanings, how to use each colour in design work, and which colours work best together.

3.12 Hue, Saturation and Value

Colour is derived from sunlight and depends on illumination to make itself apparent. When full daylight is broken up by passage through some transparent medium like rain or glass prism, colour reveals its true richness in the form of a rainbow. The colours that we perceive in the rainbow are called hues.

1. Hue:



Figure 3.10: This strip shows a range of hues. It is easy to point to “red” or “blue” or “yellow.”

Hue is the colour reflected from or transmitted through an object. It is measured as a location on the standard colour wheel, expressed as a degree between 0° and 360°. In common use, hue is identified by the name of the colour such as red, orange, or green. is the name of a distinct colour of the spectrum – red, green, yellow, orange, blue, and so on. It is the particular wavelength frequency.

2. Saturation

Fully saturated colours are very rich and bright.	100% blue is a very saturated colour
Less saturated colours look muddier, or less pure.	steel blue has gray undertones

Figure 3.11: Saturation

Saturation is the "purity" of the colour. Saturation, sometimes called chroma, is the strength or purity of the colour. Saturation represents the amount of gray in proportion to the hue, measured as a percentage from 0% (gray) to 100% (fully saturated). On the standard colour wheel, saturation increases from the centre to the edge. In other words, Saturation refers to the amount of white light (or gray paint) mixed with the hue. Pastels are less saturated colours. Both of these samples below have a hue we would call "blue" but their saturation is different.

High Saturated Colours - As saturation decreases, all colours become a value of gray. You can experience reduced saturation by setting your monitor to gray-scale. Since some pure hues are darker than others, the resulting desaturated grays will also be darker – for example, compare the blue with the yellow in this chart.

3. Value (or Intensity or Lightness)

The value (sometimes called lightness or intensity or brightness) of a colour is the amount of light or white it contains. Value refers to the intensity of light present. When light is at its fullest intensity, colours will become bright, at its least intensity, colours become dim. Unlike saturation, there isn't necessarily "less" of the colour – it is just not as intense. You might think of value as being a bit like the dimmer switch on your dining room light or the brightness knob on your computer's monitor. Turn up the switch, and the value grows brighter.

3.13 Tint, Shade and Tone

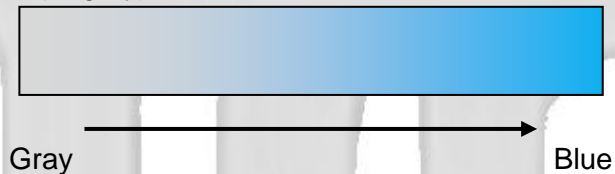
1. **Tint** – is a mixture of pure hue and white. Think of a colour like red saturated with lots of white. As more white is added the colour becomes a lighter and lighter tint of red, until it turns to pale pink.



2. **Shade** – The shade of a colour is obtained by mixing black colour in it. For example, brown is the dark shade of red.



3. **Tone** – Any colour that is mixed with a combination of both, black as well as white (or gray) is referred to as the tone of that colour.



4. **High Key** – Suppose a complete picture is painted in the graded order of tints, and depicts a fairly bright condition, then such a colour scheme is known as a light scheme or high key.

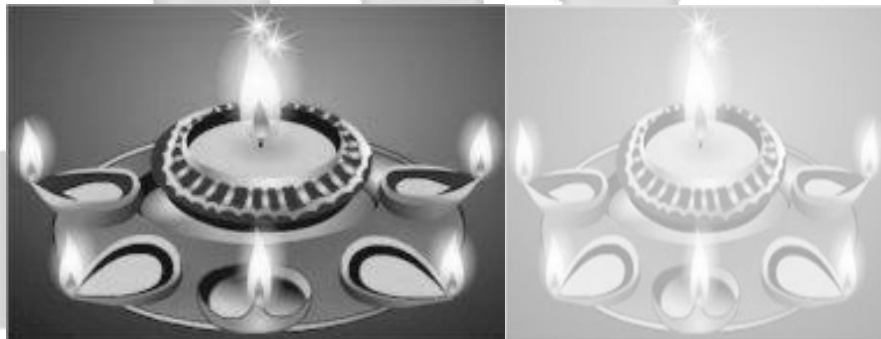


Figure 3.12: Bright picture made with tints is termed as High-Key

5. **Low Key** – In case a complete picture is painted in the graded order of shades, it indicates a dark state, and then such a colour scheme is known as a heavy scheme or low key.



Figure 3.13: Picture made with shades that is termed as Low-Key

3.14 Transparent, Opaque and Colour Harmony

1. **Transparent Colours** – Materials like air, water, and clear glass are called transparent. When light encounters transparent materials, almost all of it passes directly through them. Glass, for example, is transparent to all visible light. The colour of a transparent object depends on the colour of light it transmits. If green light passes through a transparent object, the emerging light is green; similarly if red light passes through a transparent object, the emerging light is red.
2. **Opaque Colour** – Most materials are opaque. When light strikes an opaque object none of it passes through. Most of the light is either reflected by the object or absorbed and converted to **heat**. Materials such as **wood**, stone, and metals are opaque to visible light.
3. **Colour Harmony** - Harmonic colours are sets of two or more colour relationships that have been found to be pleasing to the eye. They are described by their relative positions around the colour wheel. Specifically, harmonic colours can be described by the degrees of area around the HSV colour wheel and their angle(s) of separation.

3.15 Colour modes and models

A colour mode determines the colour model used to display and print images. Common models are as follows:

1. HSB (hue, saturation, brightness)

2. RGB (red, green, blue)
3. CMYK (cyan, magenta, yellow, black)
4. CIE L*a*b*

3.15.1 HSB model

The HSB model describes three fundamental characteristics of color based on the human perception of colour i.e. Hue, saturation, Brightness Hue is the colour reflected from or transmitted through an object. It is measured as a location on the standard colour wheel, expressed as a degree between 0° and 360°. In common use, hue is identified by the name of the colour such as red, orange, or green.

Saturation, sometimes called chroma, is the strength or purity of the color. Saturation represents the amount of gray in proportion to the hue, measured as a percentage from 0% (gray) to 100% (fully saturated). On the standard color wheel, saturation increases from the center to the edge.

Brightness is the relative lightness or darkness of the colour, usually measured as a percentage from 0% (black) to 100% (white). Although we can use the HSB model to define a color in the Color palette or Color Picker dialog box, there is no HSB mode available for creating and editing images.

3.15.2 RGB model

A large percentage of the visible spectrum can be represented by mixing red, green, and blue (RGB) colored light in various proportions and intensities. Where the colours overlap, they create cyan, magenta, yellow, and white. Because the RGB colours combine to create white, they are also called additive colours. Adding all colours together creates white--that is, all light is transmitted back to the eye. Additive colours are used for lighting, video, and monitors. The monitor creates colour by emitting light through red, green, and blue phosphors.

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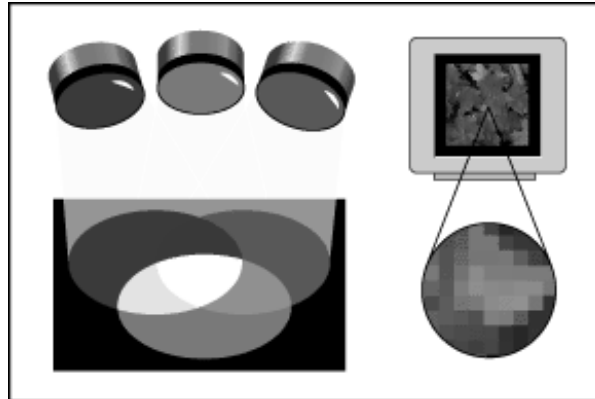


Figure 3.14: RGB Colour Model- Additive colours (RGB)

RGB mode - RGB mode uses the RGB model, assigning an intensity value to each pixel ranging from 0 (black) to 255 (white) for each of the RGB components in a colour image. For example, a bright red colour might have an **R** value of 246, a **G** value of 20, and a **B** value of 50. When the values of all three components are equal, the result is a shade of neutral gray. When the value of all components is 255, the result is pure white; when the value is 0, pure black.

3.15.3 CMYK model

The CMYK model is based on the light-absorbing quality of ink printed on paper. As white light strikes translucent inks, part of the spectrum is absorbed and part is reflected back to our eyes.

In theory, pure cyan (C), magenta (M), and yellow (Y) pigments should combine to absorb all colours and produce black. For this reason these colours are called subtractive colours. Because all printing inks contain some impurities, these three inks actually produce a muddy brown and must be combined with black (K) ink to produce a true black. (K is used instead of B to avoid confusion with blue.) Combining these inks to reproduce colour is called four-color process printing.

The subtractive (CMY) and additive (RGB) colors are complementary colors. Each pair of subtractive colors creates an additive color, and vice versa.

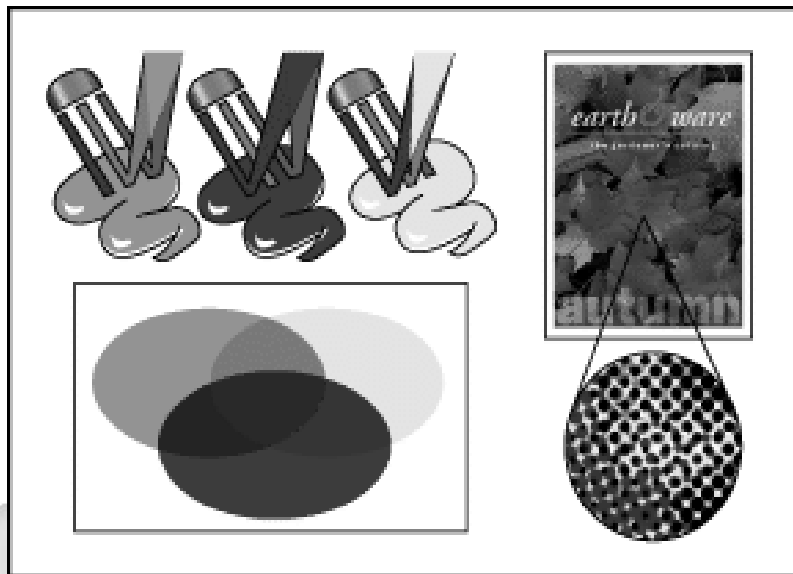


Figure 3.15: CMYK Model

CMYK mode - In CMYK mode, each pixel is assigned a percentage value for each of the process inks. The lightest (highlight) colours are assigned small percentages of process ink colours, the darker (shadow) colours higher percentages. For example, a bright red might contain 2% cyan, 93% magenta, 90% yellow, and 0% black. In CMYK images, pure white is generated when all four components have values of 0%.

Use the CMYK mode when preparing an image to be printed using process colours. Converting an RGB image into CMYK creates a colour separation. If we start with an RGB image, it's best to edit first and then convert to CMYK. In RGB mode, we can use the Proof Setup commands to simulate the effects of a CMYK conversion without changing the actual image data. We can also use CMYK mode to work directly with CMYK images scanned or imported from high-end systems.

3.15.4 L*a*b model

The L*a*b color model is based on the model proposed by the Commission Internationale d'Eclairage (CIE) in 1931 as an international standard for color measurement. In 1976, this model was refined and named CIE L*a*b. L*a*b color is designed to be device independent, creating consistent color

regardless of the device (such as a monitor, printer, computer, or scanner) used to create or output the image.

L*a*b color consists of a luminance or lightness component (L) and two chromatic components: “A” component (from green to red) and the “B” component (from blue to yellow).

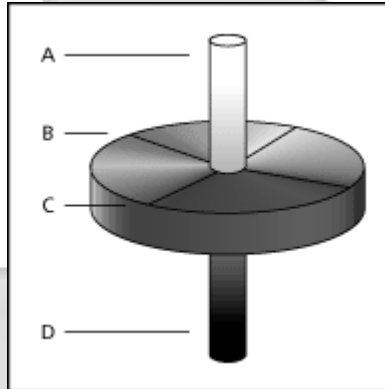


Figure 3.16: * a * b Colour Model

**A) Luminance=100 (white) B) Green to red component
C) Blue to yellow component D) Luminance=0 (black)**

3.15.5 Lab model

Lab mode has a lightness component (L) that can range from 0 to 100. The component (green-red axis) and the b component (blue-yellow axis) can range from +120 to -120. We can use Lab mode to work with Photo CD images, edit the luminance and the colour values in an image independently, move images between systems, and print to PostScript® Level 2 and Level 3 printers. To print Lab images to other colour PostScript devices, convert to CMYK first.

3.15.6 Bitmap mode

This mode uses one of two color values (black or white) to represent the pixels in an image. Images in Bitmap mode are called bitmapped 1-bit images because they have a bit depth of 1.

3.16.7 Grayscale mode

This mode uses up to 256 shades of gray. Every pixel of a grayscale image has a brightness value ranging from 0 (black) to 255 (white). Grayscale

values can also be measured as percentages of black ink coverage (0% is equal to white, 100% to black). Images produced using black-and-white or grayscale scanners typically are displayed in Grayscale mode. Although Grayscale is a standard colour model, the exact range of grays represented can vary, depending on the printing conditions.

Self Assessment Questions (MCQ's)

1. _____ are terms that refer to a variation of a hue.
2. _____ is the most misunderstood colour.
3. Primary colours are _____
4. _____ Colour is a colour made by mixing two primary colours together: red and yellow to get orange, yellow and blue to get green, or red and blue to get purple.
5. _____ colours are obtained by mixing a Primary and a Secondary colour together.

3.16 Summary

- Colour is the perceptual characteristic of light described by a colour name.
- A colour is described in three ways: by its name, how pure or desaturated it is, and its value or lightness.
- Colour is the by-product of the spectrum of light, as it is reflected or absorbed, as received by the human eye and processed by the human brain.
- There are three primary colours: red, blue, and yellow.
- Green is the colour of nature, fertility and life.
- A secondary colour is a colour made by mixing two primary colours together: red and yellow to get orange, yellow and blue to get green, or red and blue to get purple.
- Tertiary colours are obtained by mixing a Primary and a Secondary colour together.
- Red, Orange and some Yellows and Purples are considered to be warm colours.
- Saturation is the "purity" of the colour. Saturation, sometimes called chroma, is the strength or purity of the colour.

- Transparent Colours – Materials like air, water, and clear glass are called transparent.
- The HSB model describes three fundamental characteristics of colour based on the human perception of colour i.e. Hue, saturation, Brightness
- Colour is the ingredient that makes objects appealing, attractive and gives pleasure to the observer.

3.17 Terminal Questions

- 1) What is colour?
- 2) What are the characteristics of colour?
- 3) What is the difference between primary and secondary colour?
- 4) Briefly explain analogous.
- 5) Write a short note on: Colour modes and models.

3.18 Answer

Answer to Self Assessment Questions

- 1) Shade and tint
- 2) Black
- 3) Red, blue, and yellow
- 4) Secondary
- 5) Tertiary

Answers to Terminal Questions

1. Colour is the perceptual characteristic of light described by a colour name. (Refer section 3.0).
2. There is a great relationship between colours and human nature. One's mood changes according to the colour of the clothing that one wears. The influence of colour on human life is very interesting. (Refer section 3.3).
3. Primary colours form the basis for colour theory or colour mixing, as using these three colours it's possible to mix most other colours. (Refer section 3.5 and 3.6).
4. Analogous colours or related colours are that nearly like one another and close together on the colour wheel. Such a colours scheme formulates unity. (Refer section 3.7).
5. A colour mode determines the colour model used to display and print images. (Refer section 3.16).

Unit 4

Typography

Structure:

- 4.1 Introduction
 - Objective
- 4.2 Ancient Writing System
- 4.3 Clear communication and good design
- 4.4 The world of typography
- 4.5 Current Overview: 20th Century Overview
- 4.6 Typeface and Fonts
 - 4.6.1 Measuring/Spacing Type
 - 4.6.2 Type Height
 - 4.6.3 Understanding the Basics
- 4.7 Type Alignment
- 4.8 Type Width
- 4.9 Tracking and kerning
- 4.10 Tracking is Overall Letter spacing
 - 4.10.1 Creative Letter spacing with Kerning and Tracking
 - 4.10.2 Optical Adjustments to typefaces
- 4.11 Font Family
- 4.12 True type fonts
 - 4.12.1 TrueType fonts on the PC and the Mac
 - 4.12.2 PostScript fonts
- 4.13 Bitmapped and Outline (scalable fonts)
- 4.14 Classification of font
- 4.15 Font Styles
- 4.16 Readability/Legibility
- 4.17 The Flow in Typography
 - 4.17.1 Text formatting
- 4.18 How to select font
- 4.19 Calligraphy
- 4.20 Text in multimedia application
- 4.21 Summary
- 4.22 Terminal Questions
- 4.23 Answer

4.1 Introduction

Typography is the design and use of typefaces as a means of visual communication from calligraphy to the ever-developing use of digital type. Typography is sometimes seen as encompassing many separate fields from the type designer who creates letterforms to the graphic designer who selects typefaces and arranges them on the page. Simply put typography is the art of print. In our daily lives we are constantly surrounded by it. Typography includes greeting cards, books, posters, newspapers, just about anything you can imagine. As simple as it may seem typography subtly combines communicative and artistic elements to create a print both pleasing and easy to read.

By understanding the underlying message that your choice of text contains, you will become more effective as you design and layout projects containing words and phrases. A picture may be worth a thousand words, but you have to know a thousand words to replace it.

Typography is the art and process of arranging type for a variety of media purposes and is made up of several parts. Take a look at the image below. Depending on the font style some or all of these parts will always be present.

Objectives:

After studying this unit, you should be able to:

- Define Ancient Writing System
- Describe typography
- Explain Typeface and Fonts
- Categorize Font family
- Define calligraphy and text in multimedia application

4.2 Ancient Writing System

The earlier forms of writings were on stone and cave walls comprising of cuneiforms images. Original ancient text can be traced back to the middle ages. The design of type began with early cuneiform images carved into stone or painted on cave walls. The tradition expanded into black letter calligraphy in the middle ages, then flourished in the industrial age with the development of Roman (serif) and then Gothic (San serif) letterforms. Now,

with the advent of PC's anyone can create a typeface; there are literally thousands available.

4.3 Clear communication and good design

A small font or one that is fuzzy is obviously hard to read which makes the intended message difficult to understand. Good typography is not only clear and legible but easy and pleasant to read. Typographers achieve this by selecting the right fonts, lettering and print types. A typographer also makes sure that the right lettering design has been chosen to convey the intended effect of the print. For example newspapers, being a source of news and facts, typically have a straightforward, black print fonts, while on the other hand wedding invitations are more ornate and elegant in accord with the happy occasion they announce.

4.4 The world of typography

Typography is an enormous field that has both digital and physical applications. Jobs in this field include everything from graphic designers who choose type and position them on the page to type designers that craft letter styles. Modern day typography includes more and more digital work related to the internet and other computer-related projects. For print lettering to be successful it must complete two basic roles: it must clearly communicate the intended message and do so in a visually effective way that takes into account the design element. A print type that can do those two things is readable, artistic and attractive.

4.5 Current Overview: 20th Century Overview

During the 20th century, styles in book design, as in all the arts, fine or applied, have become increasingly international. Styles born in one country spread throughout the world and die through overuse at a dizzying rate. As a consequence, it has become increasingly difficult to distinguish truly individual or national styles. Books, magazines, cloths, paintings, and music irrespective of the country of origin, all resemble one another far more than they differ.

4.6 Typeface and Fonts

The life of the text lies in typefaces and fonts. Sheer artistry is possible by manipulating these to suit the requirement. Although typeface and font are often used interchangeably, a typeface refers to a type family, such as Times Roman, Avant Garde or Frutiger, while a font refers to a single instance of one of these typefaces, such as Frutiger light, Frutiger Roman or Frutiger Roman Italic.

4.6.1 Measuring/Spacing Type

To understand how type works, you must know how it is measured. Basically, typefaces can be measured in two ways namely height and width.

4.6.2 Type Height

In earlier times when type was molded out of metal, it was sold in discrete sizes that were measured in points. Today's digital types can be enlarged or reduced by simply selecting or specifying a point size. Required type height can be easily obtained through point size.

14 Points

18 Points

36 Points

72 Points

Figure 4.1: Various Font type heights

Originally, the term point size referred to the height of the metal body that held the characters. This was slightly larger than the distance from the highest to the lowest feature in the design.

A traditional point is approximately $1/72$ of an inch or .01384 inch.

4.6.3 Understanding the Basics

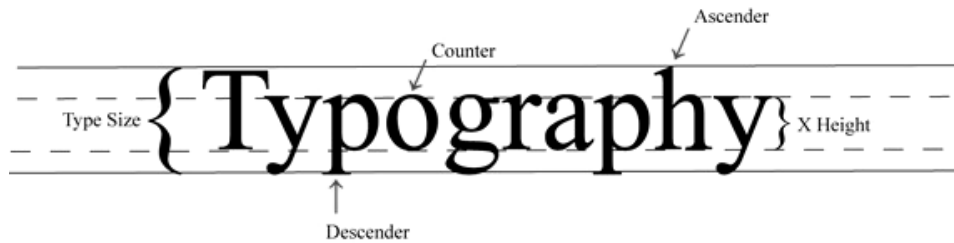


Figure 4.2: Components of typography

- The **Type Size**, also called the **Cap Height**, is the overall height of capital letters in the formation of words.
- The **Ascender** is the upward tail on letters like h, l, t, b, d, and k.
- The **Descender** is the downward tail for letters like g, q, and y.
- The **Counter** is the white space located inside letters like o and p.
- The **X Height** is the height of the letter, and does not include ascenders or descenders.
- **Baselines** are the boundary that the lowest part of the letter rests on. Take a look at the y, p, g, p and y letters in the illustration above. The solid line they are resting on is the baseline.

Have you ever seen a paragraph or advertisement that made the letters appear either spaced way out or scrunched all up so it was hard to read? The effective use of kerning and leading will fix that problem. Kerning is the space located between individual letters of a word. If you can remember the kernels on an ear of corn, it's easy. When the kernels of corn line up, it makes a nice neat row.

If the kerning is off, so will the appearance of the word or line of text you are working with and it will be harder to read.

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Kerning
 ↓
Typography
 consists of
 Leading → Letters
 called
FONTS

Figure 4.3: Illustration of Kerning and Leading

Leading is the space between the lines of text. If you look at the illustration above, you will quickly notice the space between line one and two is too close, giving the impression of not enough space. By adjusting the amount of leading between lines, the text becomes much more readable and less pinched.

How do you want your text to line up? Is this a standard body of text, a headline or are you in need of a more professional finish? Depending on the **type alignment**, you may inadvertently create the wrong impact based solely on the placement of your message.

Type Alignment

<p>Left alignment is the most common and is easy to read usually indicative of body text.</p>	<p>Center Alignment is used for Headings or Titles</p>	<p>Right Alignment is used for a more professional look and is frequently used for business cards</p>
---	--	---

Left alignment

Center alignment

Right alignment

Figure 4.4: various font alignments

4.7 Type Alignment

- Default writing techniques will use **left alignment** to create easy to read text for the reader. Casual letters, unpublished manuscripts, and basic paragraph styles tend to fall into this category.
- **Center alignment** is used to draw attention and is used a majority of the time for Headlines or Titles. Newspaper headers, book titles, and report titles are excellent examples of center alignment.
- **Right Alignment** is a clean crisp professional look and is used quite a bit for corporate business letters, return address labels, business cards and a variety of other applications where a formal style of alignment is needed.
- **Justified alignment** is usually reserved for newspaper print and body text for textbooks, and is more difficult to work with. This type of alignment creates perfect alignment on both the left and right margins without regard for the actual characters. This can lead to a condition called **tracking**, or the creation of “*rivers*” of white space throughout the text body. If this happens, reduce the tracking gradually to correct the illusion.

Now that we know how to identify the parts, make sure the spacing is correct and we've decided on the image we want to portray, selecting what your message will look like is paramount to leaving the gravy off the mashed potatoes at dinner. You're still going to have a nice dinner, but if you want to get saucy, pick a type category that fits.

- **Serif** type has extensions or strokes on the ends of the letters. Times New Roman is a perfect example of this. This type of font is easy to read for longer pieces and tends to be a little more conservative. If you do not deliberately choose another font, most programs default to the Times New Roman style.
- **San-Serif** does not have extensions or strokes on the ends of the letters and are used heavily for labeling, headlines and titles. This is also easy to read with a more contemporary feel to it. Children's books use this because it is more easily identifiable as children are learning the alphabet.
- **Script, symbols and decorative type** are all styles of type categories to create a specific image or message. Weddings might lean more

toward the fluid motion of a script type while a child's birthday might be more inclined to like a decorative font from a favorite movie.

Whatever font family you choose bears careful consideration in the design of any piece. Here are a few suggestions to get you started:

- The font you decide on should not dominate the piece. Fonts are like exquisite jewellery to be placed in just the right context to insure maximum results.
- Use care when mixing fonts. It's kind of like mixing stripes and plaids. When in doubt, stay with something a little more conservative then add one splash of *notice me*.
- Use consistency in your layouts. If you start out using an Arial font for the headers, stay with the same font throughout the piece.
- Newsletters with columns will look better if you use the Justified Alignment. Make sure you don't create rivers of white space though.
- Use an 11 or 12 point font size and a serif type for maximum readability.
- Use *Italics* and Bold to point out areas of interest or draw quick reference to information.
- Use colour for emphasis. Remember, reds draw the most attention if used correctly. It is amazing what one spot of red can do for an ordinary ad.

4.8 Type Width

In addition to height, a typeface is commonly measured by its width. The width of a typefaces is often expressed in characters per pica, that is, the average number of character that will fit within a pica. The character-per-pica information is used for copy fitting to estimate whether text set in a specific typeface will fit into an allotted space or conversely, to estimate how much space given piece of text will occupy. This information can also be used to compare the relative width of different typefaces.

4.9 Tracking and kerning

Tracking adjust the space between three or more selected characters. This is often used to adjust the letter and word spacing for an entire line of text or a paragraph of text. Kerning adjust the space between two characters or between two words. To adjust tracking, highlight the text to be adjusted with

the Text Tool and then increase or decrease the Tracking amount. A minus amount decreases the space while a higher number increase it.

Kerning information for many commonly kerned character pairs is built-in to most quality fonts. Some software programs use these built-in kerning tables to apply automatic kerning to text. Each application provides varying amounts of support for built-in kerning information and may support only Type 1 or only TrueType kerning data.

Anywhere from 50 to 1000 or more kerning pairs may be defined for any one font. A handful of the thousands of possible kerning pairs: **Ay AW F, KO and wa.**

Headlines usually benefit from kerning and text set in ALL CAPS almost always requires kerning for best appearance. Depending on the font and the actual characters used, automatic kerning without manual intervention may be sufficient for most publications.

4.10 Tracking is Overall Letter spacing

Tracking differs from kerning in that tracking is the adjustment of space for groups of letters and entire blocks of text. Use tracking to change the overall appearance and readability of the text, making it more open and airy or more dense.

Can apply tracking to all text or selected portions. You can use selective tracking to squeeze more characters onto a line to save space or prevent a few words from carrying over to another page or column of text.

Tracking often changes line endings and shortens lines of text. Tracking can be further adjusted on individual lines or words to improve hyphenation and line endings.

Tracking should not replace careful copy fitting. Use tracking adjustments carefully and avoid extreme changes in the tracking (loose or normal tracking following by a line or two of very tight tracking) within the same paragraph or adjacent paragraphs.

Note: The terms letter spacing and character spacing may refer to kerning or tracking, depending on the software application.

In addition to the standard kerning and tracking methods found in word processing and desktop publishing software, some programs allow additional adjustments. For example, QuarkXPress allows the user to edit the kerning tables. This lets the user improve the kerning information in a font or add new kerning pairs so that manual adjustments are minimized for other incidents of that font repeated throughout the document.

Users can permanently customize the kerning information for a font using a font editor kerning utility. This can cause variations in the appearance of the text when the document is shared with others using the same font but not the customized version. Custom kerning data is, however, preserved when fonts are embedded in an Acrobat PDF document.

4.10.1 Creative Letter spacing with Kerning and Tracking

Kerning and tracking can also be applied to text to create special text effects for headlines, subheads, newsletter nameplates, and logos.

Exaggerated tracking can produce an effective and eye-catching title. Extreme kerning or over-kerning creates special effects with tightly spaced or overlapping characters, perhaps for a newsletter nameplate.

4.10.2 Optical Adjustments to typefaces

Optical scaling refers to scaling the size of type in a non-uniform manner by making alterations in character shapes and spacing. Optical scaling makes small type sizes more readable and large type size more aesthetic. Exactly how this is to be done is the responsibility of the type or font designer. But the optical adjustments are abandoned in the digital era.

The biggest problem with this approach is that the optimum optical scaling adjustments required depend not only on size, but also on properties of the final output product upon which the result will be viewed.

4.11 Font Family

A set of fonts all with the same typeface, but with different sizes, weights and slants.

As for the families, there are five of them, which correspond to the five generic-family values: serif, san-serif, monospace, cursive, and fantasy. Serif fonts are much more traditional print-page-looking fonts, like Times or New century schoolbook. If you look closely, the strokes in each letter have

areas which are thinner and thicker, as though inscribed with a pen. Sans-serif fonts, on the other hand, are somewhat simpler, with every stroke of a consistent width throughout its length; examples are Helvetica, Arial, and Verdana. Most serif and sans serif fonts come with variations of weight (boldness), width (condensed or extended) and italics.

Serif Fonts:

Serif fonts are marked by little 'feet' that extend from the stem of the letter. All fonts were roman (serif) until the 20th century. Serifs say tradition, elegance, formal. Serifs enable reading of large blocks or printed text, hence most books, magazines, etc. Use it for body text.

Type of serif fonts:

Old style: With some of the earliest fonts, the serif flow out in simple, graceful curves. Example: Caslon, Caxton, Garamond, Goudy, Oldstyle, Palatino, Early Roman.

Transitional: Smaller curves connect the serifs. Examples: Baskerville, Century, Tiffany, Times.

Modern: The stems are thick and the serifs thin, contrasting with each other. Example: Bodoni.

Egyptian: Slab serifs. Thick Circus, Westerns. Examples: Clarendon, Lubalin, Memphis.

Sans Serif Fonts:

The crisp, clean, uncluttered lines of these sans serif fonts are perennial favorites that designers turn to again and again. Within each grouping are many varieties and renditions, some more suitable than others for body copy.

No 'feet' clean, simple lines, less traditional looking. Hugely popular in the mid-century Swiss design movement. Example: Helvetica, Univers, Futura, Avant Grade. Gill Sans.

Studies show that reading on-screen is easier with sans-serif typefaces. So designers have been charged with creating new, easy to read styles for web use like Verdana, Arial and Trebuchet are a few.

4.12 True type fonts

TrueType is a digital font technology designed by Apple Computer, and now used by both Apple and Microsoft in their operating systems. Microsoft has distributed millions of quality TrueType fonts in hundreds of different styles, including them in its range of products and the popular TrueType Font Packs. TrueType fonts offer the highest possible quality on computer screens and printers, and include a range of features which make them easy to use.

TTF is Microsoft's de-facto standard for Windows & Windows Applications. You can use TTF in any pure Windows Application. The true type font technology consists of two components namely the true type fonts themselves, which come in many thousands of different styles, and can be purchased individually or in collections from font manufacturers; and the TrueType rasterizer, a piece of software built into System 7.x on the Apple Macintosh range of computers, and also into Microsoft's Windows family of operating systems.

Both components viz. The font and the rasterizer, are necessary to display and print true type fonts on a computer system. It is the interaction between the true type fonts, the true type rasterizer and the software program in which the true type font is used that determines the appearance of the letterforms in the font. If you're using a Mac or a Windows machine, the chances are that you're already using the true type rasterizer and the true type fonts that both Apple and Microsoft include with the basic operating system.

4.12.1 TrueType fonts on the PC and the Mac

Although TrueType fonts can be used on both, Macintosh and Windows platforms, slight differences in the way each operating system handles the fonts lead vendors to produce separate versions of the font for each platform. Some vendors will provide you with both Mac and Windows format TrueType files, while others may treat them as different products.

This oddity arises because of the different file system used on the two platforms. Information can be included in the font to determine whether the font can be used on both kinds of system, or one or the other.

On a Macintosh, the TrueType font file is sometimes referred to as an SFNT and, under Windows as a **.TTF**. The information contained in the fonts is the same, and making the necessary adjustments to allow the font to run on both platforms is a relatively straightforward task.

4.12.2 PostScript fonts

As with other computer fonts, PostScript fonts are numerous and take up too much space. There are several basic and familiar fonts and hundreds more that many feel they must have. Unless you really have a specific need or exotic tastes, the basic fonts will probably be adequate. Printers generally come with basic dozen or so fonts, with the actual number depending a lot on how you count. There are hundreds of additional fonts for those who feel they must have more to be complete.

Some common PostScript fonts are:

#	Font Name	#	Font Name
0	Helvetica	17	Bookman-Demi
1	Helvetica-Bold	18	Bookman-DemiItalic
2	<i>Helvetica-Oblique</i>	19	Bookman-Light
3	Helvetica-BoldOblique	20	<i>Bookman-LightItalic</i>
4	Times-Roman	21	Helvetica-Narrow
5	Times-Bold	22	Helvetica-Narrow-Bold
6	<i>Times-Italic</i>	23	<i>Helvetica-Narrow-Oblique</i>
7	Times-BoldItalic	24	Helvetica-Narrow-BoldOblique
8	Courier	25	NewCenturySchlbk-Roman
9	Courier-Bold	26	<i>NewCenturySchlbk-Italic</i>
10	<i>Courier-Oblique</i>	27	NewCenturySchlbk-Bold
11	Courier-BoldOblique	28	NewCenturySchlbk-BoldItalic
12	Συμβολ (Symbol)	29	Palatino-Roman
13	AvantGarde-Book	30	<i>Palatino-Italic</i>
14	<i>AvantGarde-BookOblique</i>	31	Palatino-Bold
15	AvantGarde-Demi	32	Palatino-BoldItalic
16	AvantGarde-DemiOblique	33	<i>ZapfChancery-MediumItalic</i>
		34	*□*+*■*◎*▼▲ (ZapfDingbats)

Figure 4.5: Standard 34 PostScript fonts

These fonts are also known as Type 1 fonts or ATM fonts. Except for Windows NT, 2000 and XP, you need an extra program called Adobe Type Manager (or ATM for short.) You can get ATM from PC dealers. Postscript fonts have two parts: Printer fonts and screen fonts.

A printer font instructs the printer how to print the type on paper (or other media).

A screen font instructs the computer how to draw it on the screen.

PostScript fonts are defined by their outline. What is stored is not a map of the bits making up the actual characters, but rather a description of how to draw them, or more precisely, their outlines. The advantage of outline fonts is that they can be precisely scaled to an infinite number of sizes, even fractional sizes, and still look good. Fixed size bit map fonts, in contrast, are harder to scale and often contain rough corners. Outline fonts are drawn with the full resolution of the printer instead of the fixed resolution in which the bit map was created.

PostScript Type 1 fonts are considered the industry standard and are the most reliable when printing to high-end digital devices such as image setters and digital presses. Type 3 fonts are the original non Adobe Post Script font description standard. This standard is dying and type foundries have all moved to the Type 1 standard. Multiple Masters were developed by Adobe to give users the ability to manipulate one or more design axes and thus providing one with tremendous flexibility and control over the type. Multiple Masters are also Type 1 fonts.

4.13 Bitmapped and Outline (scalable fonts)

It's analogous to asking what the difference is between various graphics image file formats. The short, somewhat pragmatic answer, is simply that they are different ways of representing the same "information" and some of them will work with your software/printer and others won't.

At one level, there are two major sorts of fonts namely bitmapped and outline (scalable). Bitmapped fonts are falling out of fashion as various outline technologies grow in popularity and support.

Bitmapped fonts represent each character as a rectangular grid of pixels. The bitmap for each character indicates precisely what pixels should be on and off. Printing a bitmapped character is simply a matter of blasting the right bits out to the printer. There are a number of disadvantages to this approach. The bitmap represents a particular instance of the character at a particular size and resolution. It is very difficult to change the size, shape, or

resolution of a bitmapped character without significant loss of quality in the image. On the other hand, it's easy to do things like shading and filling with bitmapped characters.

Outline fonts represent each character mathematically as a series of lines, curves, and 'hints'. When a character from an outline font is to be printed, it must be 'rasterized' into a bitmap "on the fly". PostScript printers, for example, do this in the print engine. If the 'engine' in the output device cannot do the rasterizing, some front end has to do it first. Many of the disadvantages that are inherent in the bitmapped format are not present in outline fonts at all. Because an outline font is represented mathematically, it can be drawn at any reasonable size. At small sizes, the font renderer is guided by the 'hints' in the font; at very small sizes, particularly on low-resolution output devices such as screens, automatically scaled fonts become unreadable, and hand-tuned bitmaps are a better choice. Additionally, because it is rasterized "on demand," the font can be adjusted for different resolutions and 'aspect ratios'.

4.14 Classification of font

Many of the more popular typefaces used today are available in three different alternatives:

- Commercial font
- Expert font
- PI font

1. Commercial font

A commercial type font contains the usual range of characters that are needed for most forms of typesetting, i.e. 'one complete assortment of alphabet letters comprised of capitals and lower case, numerals, punctuation, special characters, and symbols. A type font is only available in one specific typeface design. Therefore, a typeface such as 10 points Times Roman is considered to be *one* font while a 10 points Times Bold is another.



Figure 4.6: Showing Commercial fonts

Extra care must be taken when working across two or more platforms because certain characters from the same font and type foundry, accessible on the PC platform, are unavailable for the Apple Mac.

2. Expert fonts:

Currently, Expert fonts are limited to those fonts, which are the most popular typefaces. These fonts contain special characters such as 'ligatures', 'small caps' and 'swash' letters that are not normally used, or needed, in the everyday world of commercial typesetting. For certain classes of bookwork and high-class typesetting purposes, their inclusion forms an invaluable addition to the finished result. Expert fonts have restricted usage limited to high-class typesetting purposes. They contain special character that are seldom used in normal publications, their requirement, however, being vital in high finished result.

typesetting needs. Pi fonts usually contain a collection of special characters such as mathematical, monetary or decorative symbols, etc.

If you have a special need for certain characters, most manufacturers will make a pi font to fit your need using standard characters or even develop a new one to suit you. Symbol, Carta, and Zapf Dingbats are examples of common pi fonts.

4.15 Font Styles

Changing the look of the font can bring different meaning or clarity to a document. Below are some of the examples of the common font styles.

1. **For Helvetica:**

This is upright, this is backslant, this is italic, and this is oblique. This is bold upright, this is bold backslant, this is bold italic, and this is bold oblique.

2. **For Times:**

This is upright, this is backslant, this is italic, and this is oblique. This is bold upright. This is bold backslant, this is bold italic, and this is bold oblique.

3. **For Courier:**

This is upright, this is backslant, this is italic, and this is oblique. This is bold upright. This is bold backslant, this is bold italic, and this is bold oblique.

4.16 Readability/Legibility

In typography, readability refers to the ease of physically reading a given body of text. Legibility refers to the ease of distinguishing individual letterforms and, as a result, the ease of recognizing words.

Legibility vs. readability: A distinction is sometimes drawn between "legibility" and "readability." "Legibility," in this sense, is said to refer to individual characters, whereas "readability" is a characteristic of groups of letters (words, sentences, etc.).

This is a useful distinction, as printed text is often more legible than readable (as in some newspapers, for instance), or more readable than legible (as in many advertising logos).

Doctor

Doctor

Figure 4.8: Proper fonts

You don't have to choose an **obvious** font, such as a flowery script for a perfume advertisement or a blocky sans serif for auto parts. The important thing is to serve the **values** that the text stands for.

4.17 The Flow in Typography

Headlines: Stop them and grab them, fast. Headlines work best when they're both visually and verbally interesting. The largest type on the page that is the headings should always stand out from subheads and body copy, although they don't have to be located at the top.

Subheads: Hook them into reading more, by expanding and explaining the basic idea of the headline. Distinguish these from heads and copy.

Body text: Make sure it's both, legible and inviting.

Captions: Connect readers to pictures and story. Often, these are a bit larger than body text. Be consistent.

Pull quotes and other breakouts: Add interest. Be creative. Design with these **relative positions** in mind, exploiting all the variations used for emphasis and legibility.

4.17.1 Text formatting

These variables are the key to differentiating the levels of typographic hierarchy. They work pretty much the same for print or web design. Just

remember to use consistent formatting at each level, for instance, all subheads should look the same, all body copy the same, etc.

Size: The larger the type, the more it jumps out (but if body text is too large it looks like it's intended for the blind).

Weight: Use light against bold for emphasis.

Alignment: Flush left, rag right. Remember that in the west, people read from left to right, so the eyes prefer a hard edge along the left side. Most body copy these days are set on flush left.

Alignment: Centered. Don't center body copy or much text at all. Great for big, bold headlines.

Alignment: Flush right, ragged left. Use only in rare circumstances. The reader's eyes have a hard time finding the next line.

Alignment: Justified, or force justified. Pushes type to both edges of margin. Makes nice, straight columns, but there's a trade off: Uneven letter spacing can create rivers of white space, especially if the column width is narrow.

Case: ALL CAPS IS HARD TO READ IN LARGE DOSES but grabs attention with its authority. Lower case connotes friendly, low stress, easy text.

Leading: The space between lines. Open it up to invite busy readers into your text. With too much leading, our eyes have to leap from line to line.

Space: Use air around words for emphasis, to set them off, especially if they're bold. Keep spacing consistent, such as the amount of added "air" between chunks of text.

Text width: Legibility studies show that the ideal column width is about 36 characters, or 1-1/2 times the alphabet. Small amounts of text can be placed in narrower columns.

Indents: Use indents to set off a subhead/category by leaving extra space to the left and/or right margin of the text below.

4.18 How to select font

Every font has a character, or tone, which communicates on a visual level. Once you are clear on the tone of the message, look for fonts that

communicate the same qualities: Is it light, serious, wry, nostalgic, upbeat, spiritual, technical, and fun?



Figure 4.9: Different types of fonts

There are so many fonts available, but few are good, well-designed fonts. Use fonts from established type houses such as **Bitstream** and **Adobe**. Although they are expensive, these fonts should read well in all sizes and uses, with good letter spacing.

Avoid so-called free fonts that you can get from the Internet. Most are terribly gimmicky. Plus, you'll probably have to spend extra time trying to make the spacing between the letters look right.

4.19 Calligraphy

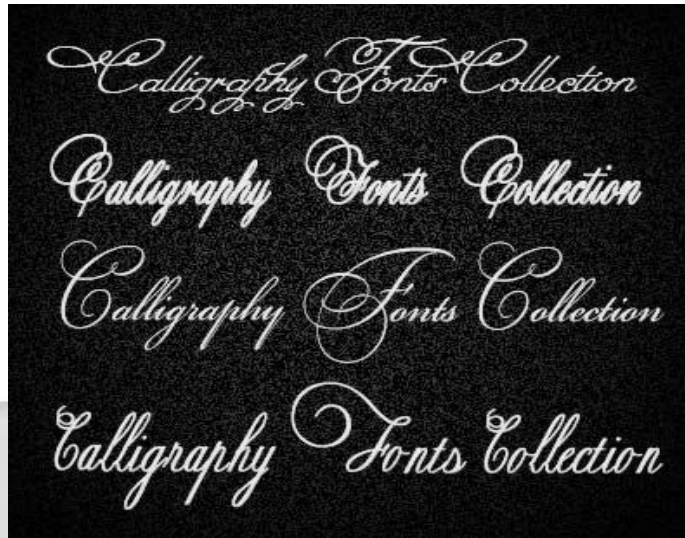


Figure 4.10: Different styles of Calligraphy

Calligraphy is the art of writing script in such a way as to express the beauty of what is being written in the formation of the letters themselves.

The word calligraphy literally means beautiful writing. Before the invention of the printing press some 500 years ago, it was the way books were made, each copy being written out by hand by a scribe in a scriptorium on materials like vellum or parchment with a quill in one of the period bookhands like rustic, carolingian, blackletter, etc.

Calligraphy claims ancient roots in the first recorded forms of expression: the cave paintings of our ancestors some 25,000-30,000 years ago. Eventually this form of pictorial communication became stylized around 3500 B.C. with the development of Egyptian hieroglyphics. The Phoenicians followed circa 1000 B.C. with one of the earliest alphabets – an entirely different writing system in that each symbol represented a sound rather than an idea or picture. The Phoenician alphabet was adopted and modified by many peoples, including the Greeks. The Romans picked up the Greek alphabet and adapted it to suit Latin.

Latin brings us to the beginnings of what many people think of as modern calligraphy. It was the language of the all-powerful churches of the middle Ages, and monks were among the only literate members of society. One of their tasks was committing the word of God to paper, by scribing ancient texts into ornamental volumes to be read by holy elite and royalty.

The monks infused the script with a flourishing style that would add glory to the letters themselves as if to make the inscriptions worthy of the holy words they were conveying. The style was also economically narrow to save expensive paper. It became known as Gothic and was the original form of European calligraphy as we think of it today.

By the mid-15th century the printing press was rolling out Bibles in Gothic print pre-empting the need for the monk's calligraphy skills. But beautiful penmanship became vogue among an educated society that used it for personal correspondence, formal business and social invitations. As the Renaissance took root and flourished, so did the art of calligraphy, with Italians contributing their own script, called italic. Then like the printing press before, engraved copperplates could imitate the new italic script and interest in calligraphy once again waned.

By the 19th century the flat-edged pen we associate with calligraphy had been replaced with round-tipped pens, making it difficult to produce the kinds of artistic lines needed for calligraphy. The art of calligraphy had all but died. Then British artist and poet, William Morris (1834-1896), took an interest in the lost art of beautiful penmanship and towards the end of his life reintroduced the flat-edge pen, reviving the art of calligraphy to its former glory.

Today, despite our computers that can mimic any script with clarity, calligraphy is still alive and well. Calligraphy guilds can be found around the world, including the United States, Canada, Italy, the United Kingdom, Australia and Spain

4.20 Text in multimedia application

Text is perhaps the easiest of all multimedia elements to manipulate. Most computer users have had experience with word processing and therefore, are familiar with the processes of entering and editing text and working with fonts and font sizes.

Text can be boring unless you enliven it by selecting fonts (which are analogous to typefaces in a print environment) and type sizes that are appropriate for the audience. Fonts help focus attention on certain text on the screen, enhance readability, set a tone (serious, light-hearted), and project an image (progressive, conservative). Fonts can be characterized as serif, sans serif, and decorative.

Fonts are measured in point sizes. There 72 points per inch. 10 and 12 points are common points displayed on the screen. The point size often depends on how the font is used that is, as a title, and so on. Text that appears as a title at the top of a screen may be relatively large, whereas text that is used on a button might be quite small. Some guidelines follow below:

Use	Point Size
Headings.	14-60
Subheadings	Half the heading size with a minimum, that is not smaller than the text block.
Text block	10-12

Headings and subheadings are used to attract attention and provide the user with quick identification of the screen content, while text blocks provide the substance. Subheadings must never be the text block.

Consider using **font formats** and font colours. Three common font formats are bold, *italic*, and underline. These formats are often used for emphasis in print materials. In multimedia applications, however, they are more often used to indicate that clicking on the word will hyperlink (jump to another part of the program), to display additional text (such as a definition) or some action (such as playing a sound or animation).

Use restraint and be consistent. While it may be tempting and certainly easy to use a variety of fonts, sizes, and styles, it is important to exercise restraint. Avoid too many font sizes and styles on screen. In addition, try to maintain consistency. For example, if several screens have a similar heading, use the same font, size, and style for all of the headings. Fonts can be used to express our feelings to a particular word or sentence by using some styles. Given below are some examples of how fonts are modified for the purpose of conveying a message.

Self Assessment Questions (MCQ's)

1. _____ is an enormous field that has both digital and physical applications.
2. Originally, the term point size referred to the height of the metal body that held the characters. (True/False)
3. Descender is the downward tail for letters like g, q, and y. (True/False)
4. _____ is the space between the lines of text.
5. _____ does not have extensions or strokes on the ends of the letters and are used heavily for labelling, headlines and titles.
6. _____ refers to scaling the size of type in a non-uniform manner by making alterations in character shapes and spacing.

4.21 Summary

- Typography is an enormous field that has both digital and physical applications.
- Typography is sometimes seen as encompassing many separate fields from the type designer who creates letterforms to the graphic designer who selects typefaces and arranges them on the page.
- Originally, the term point size referred to the height of the metal body that held the characters.
- Tracking adjust the space between three or more selected characters.
- TrueType is a digital font technology designed by Apple Computer, and now used by both Apple and Microsoft in their operating systems.
- The bitmap represents a particular instance of the character at a particular size and resolution.
- A commercial type font contains the usual range of characters that are needed for most forms of typesetting, i.e.' one complete assortment of alphabet letters comprised of capitals and lower case, numerals, punctuation, special characters, and symbols.
- Calligraphy is the art of writing script in such a way as to express the beauty of what is being written in the formation of the letters themselves.

4.22 Terminal Questions

- 1) Briefly explain ancient writing system.
- 2) What is font?

- 3) Write a note of Typeface and Fonts.
- 4) What is Tracking and kerning?
- 5) Briefly explain Classification of fonts.

4.23 Answer

Answer to Self Assessment Questions

- 1) Typography
- 2) True
- 3) True
- 4) Leading
- 5) San-Serif
- 6) Optical scaling

Answers to Terminal Questions

1. The earlier forms of writings were on stone and cave walls comprising of cuneiforms images. Original ancient text can be traced back to the middle ages. (Refer section 4.2).
2. Typography is the design and use of typefaces as a means of visual communication from calligraphy to the ever-developing use of digital type. (Refer section 4.1).
3. The life of the text lies in typefaces and fonts. Sheer artistry is possible by manipulating these to suit the requirement. (Refer section 4.6).
4. Tracking adjust the space between three or more selected characters. (Refer section 4.9).
5. Many of the more popular typefaces used today are available in three different alternatives: Commercial font, Expert font & PI font. (Refer section 4.14).

Manipal

Unit 5

Laws of Design

Structure

- 5.1 Introduction
 - Objectives
- 5.2 The law of balance
- 5.3 Symmetrical Balance
- 5.4 The law of rhythm
- 5.5 The law of emphasis
- 5.6 The Law of unity
- 5.7 The Law of proportion
 - Self Assessment Questions
- 5.8 Summary
- 5.9 Terminal Questions
- 5.10 Answer

5.1 Introduction

There are certain laws, which will govern the physical aspect of your design. These are not necessarily mutually exclusive and might overlap in many instances. Let us analyze the basic principles of design, which can be applied to a design or layout.

The basic laws of design include the following.	
Balance	Unity
Rhythm	Simplicity
Emphasis	Proportion

Objectives:

After studying this unit, you should be able to:

- Describe law of balance
- Explain Symmetrical Balance
- Explain law of rhythm
- Describe law of emphasis
- Explain Law of proportion

5.2 The law of balance

Balance refers to equalizing the weights of elements in a design. Formal balance is achieved when all the elements of a page are of equal weights and are placed symmetrically on the page. Informal balance may be achieved when the value, size and location of unequal elements on a page are changed. Balance is closely related to the natural law of gravity.

There are two types of balance namely Symmetrical or formal balance and Asymmetrical or informal balance.

5.3 Symmetrical Balance

Symmetry denotes mirror image meaning one side of an image is the mirror image of the other. Balance is concerned with the distribution of visual interest, which means dealing with what is located where in a composition.

There are two systems for controlling balance, which are as follows:

Inverted Symmetry:

Inverted symmetry is where the principle of symmetry is applied with half inverted like that of playing cards.



Figure 5.1: Inverted symmetry

Biaxial Symmetry

A symmetrical composition can possess more than one axis of symmetry. Biaxial symmetry employs two axis of symmetry namely vertical and horizontal.

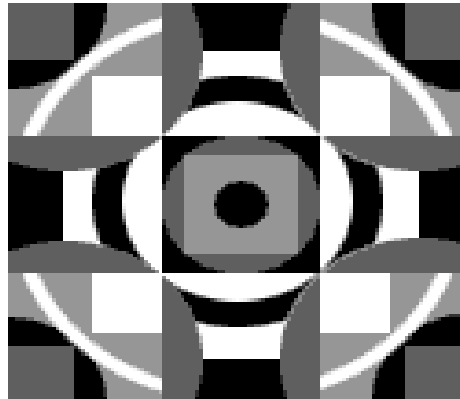


Figure 5.2: Biaxial symmetry

Radial Symmetry

Radial symmetry is a related concept and can utilize any number of axes due to the fact that here the images seem to radiate out from the centre like a star.

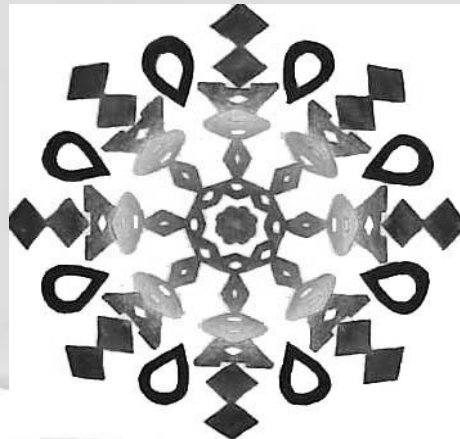


Figure 5.3: Radial symmetry

Asymmetrical Balance

Asymmetrical means without symmetry, it implies that there are no mirror images in a composition. A small visually interesting object can balance a much larger but relatively less interesting object.



Figure 5.4: Asymmetrical symmetry

5.4 The law of rhythm

Rhythm is used to create eye movement and direction. It occurs when a design element is repeated. Rhythm acts as a guide so that the eye reads important parts of a message. It is also called the denominator of the arts. Rhythm in works of art is important because it plays a vital role in our physical lives. Rhythm helps us to find order in the world.

Rhythm by repetition, progression and continuity

The artist can achieve rhythm in a number of ways, most commonly by repetition, progression and continuity. The artist can repeat something like a column in a building, the slate or a post in a garden fence, a ball of flame in the nimbus surrounding a figure cast in brass or the climbing feet in a photograph. When the artist resorts to progression in order to establish rhythm, he or she follows a plan that sets up expectations of each succeeding step. A third way achieve rhythm is by providing an easily connected and continuous flow from one form to another.

Complexities of Rhythmic Structure

Ordinarily artists use all kinds of rhythm in the same composition. They develop a combination of rhythms in any building, statue, painting or product

of the crafts, planning skilfully and subtly to make them all contribute to the total effect desired. The artists thus draw heavily on the principle of rhythm to bring order and expressive power into their use of basic elements.

5.5 The law of emphasis

Emphasis or contrast adds variety to a design. It is the variations of elements in the printed product. Some elements of a layout stand out because of contrast. This is achieved by a difference in size, colour or appearance. Some of the contrasts are: round and straight, ornate and plain, broad and narrow. Various aspects such as contrasts, dominance, isolation, floodlighting the copy with white, repetition, and radiation can bring about emphasis.

Emphasis by placement

The means by which stress is given to a shape or a quality in a work of art, whether building, statue, picture, pot or any other product are almost infinitely varied, but those most frequently encountered have to do with placement, contrast, ornamentation and action. In regard to placement, we often find an object made important merely by the position given to it in the whole arrangement.

Emphasis by contrast

Emphasis by contrast derives from many devices but that which draws on colour seems to be the most common. Contrasts of line; shape and size make for dominance of one detail over another. For example, a flower arrangement gains by placement against a quiet wall and loses by placement against a noisy screen.

Emphasis by action

Means of emphasis can be multiplied indefinitely, but the artist in actual practice combines them into organizations that vary with his intent. A composition that seems simple may in reality represent the juggling of many factors to bring them all into close relationship with each other.

5.6 The Law of Unity

Unity or harmony gives elements the appearance of belonging together. It is the proper balance of all elements to get a pleasing result as a whole. The image is viewed as one piece, as a whole, and not as separate elements.

Unity implies the union of all elements in a layout, where each part supports the other parts and all combine to form an artistic homogeneous whole. It can be achieved by continuity or harmony. The element of simplicity in a design leads to easier comprehension. It is necessary, especially in a layout, to achieve clarity.

5.7 The Law of proportion

Proportion is the relationship between size and shape. It helps to achieve balance and unity in a layout. In order to obtain good proportion, the sizes of the elements must be regulated.

Proportion is a matter of relationships namely relationships of height, width, depth and surrounding space. When the dimensions are placed together, relationships are established and it is these relationships that we judge, when we say that a table is too narrow for its length, a lampshade is out of proportion with its base and so on.

The question of scale

The amount of open space around an object creates a factor called scale. Scale too, is a matter of relationship. Note how frequently the principle of proportion figures in daily life. We go downtown to buy a lamp for an end table in the living room. In the high-ceiling showroom, we find one which pleases us and we buy it. We carry it home and set it up in our small living room only to discover that it now looks very large and clumsy. We have not changed the lamp a bit but we have changed its relationship to its surroundings and thrown it out of scale.

Static proportion and its compositional role

Certain generalities still hold regarding effectiveness of proportions. When height and width or height, width and depth are all the same, the relationship is obvious and for that reason less interesting than dimensions which offer the surprise of the unexpected or the fascination of the subtle. For example, we can equalize the rhythmic sequence of images evoked in a poem by disposing around an invisible square, the succession of miniature incidents.

Correcting proportional defects

Sometimes it becomes necessary, in art as in life, to work with a disagreeable proportion, which is unavoidable. Line can be employed in clothing to disguise undesirable proportions, while vertical stripes for the

attire of an overly bulky person and horizontal stripes for the attire of a person overly tall and slender. The principle of proportions goes hand-in-hand with the principles of balance, emphasis, rhythm, hand-in-hand, in fact with any principle.

Typographical oriented design

Design is fundamentally about communication, and, for all the power of images, words remain at the core of how we communicate. Typography is the practice of visually representing words. Type conveys meaning, both in the obvious sense that words and sentences communicate, and in the subtler sense of the particular visual representation that we use such as style, size, and so on affecting the message.

All the effort you put into our text, both in terms of content and presentation has a direct effect on the meaning of the message you convey. This is one of the most basic precepts of typography.

The IBM logo is an interesting example of how type gains meaning. Many of us see this familiar logo and think the horizontal lines are there to convey the idea that IBM makes computers. But, as it turns out, the lines are there for very different reasons: They lighten up what would otherwise be a very heavy logo while suggesting the company's authority and reliability by evoking the anti-forgery lines of financial documents. In fact, they signify "computer" to us only because of their use in the logo of a huge, highly visible computer company.

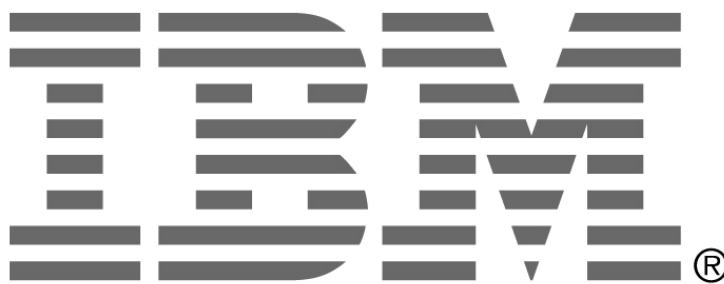


Figure 5.5: IBM logo

Unlike associational meaning, which is dependent on culture and history, visual communication comes into play on a basic human level. Hard edges evoke different emotional responses compared to soft edges.

Ornamentation, such as elaborate serifs or uneven edges, will give a different feel than sparse, unadorned letterforms. Other differences abound, including shape, thickness, color, variation, symmetry, and so on.

Self Assessment Questions

- 1) _____ refers to equalizing the weights of elements in a design.
- 2) Biaxial symmetry employs two axis of symmetry namely _____
- 3) _____ gives elements the appearance of belonging together.
- 4) _____ is the relationship between 'size and shape.

5.8 Summary

- Balance refers to equalizing the weights of elements in a design.
- Symmetry denotes mirror image meaning one side of an image is the mirror image of the other.
- Rhythm is used to create eye movement and direction.
- Emphasis or contrast adds variety to a design. It is the variations of elements in the printed product.
- Emphasis by contrast derives from many devices but that which draws on colour seems to be the most common.
- The various principles of design are not to be assumed as mere shortcuts for creation or simply rules to be memorized and applied without thinking and feeling. They codify ways of working, which artists have learned through centuries of trial and error, and therefore are more apt than other ways to succeed.
- We can see the principles of design coming into operation in the development of actual shape of an object. Among the many principles, which the artist observes one can single out and study four which are elementary and of utmost Importance.

5.9 Terminal Questions

- 1) Briefly explain laws of design.
- 2) What is inverted symmetry?
- 3) What is Radial Symmetry?
- 4) How do you define law of rhythm?
- 5) How Law of unity is differing from Law of proportion?

5.10 Answer

Answer to Self Assessment Questions

- 1) Balance
- 2) Vertical and horizontal
- 3) Unity or harmony
- 4) Proportion

Answers to Terminal Questions

1. There are certain laws, which will govern the physical aspect of your design. (Refer section 5.1).
2. Inverted symmetry is where the principle of symmetry is applied. (Refer section 5.3).
3. Radial symmetry is a related concept and can utilize any number of axes due to the fact that here the images seem to radiate out from the centre like a star. (Refer section 5.3).
4. Rhythm is used to create eye movement and direction. (Refer section 5.4).
5. Unity or harmony gives elements the appearance of belonging together. (Refer section 5.6 & 5.7).

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Unit 6

Resolution

Structure

- 6.1 Introduction
 - Objectives
- 6.2 Image Resolution
- 6.3 Pixel and Resolution
- 6.4 Image Classification
- 6.5 Image resolution VS Computer Monitor
 - 6.5.1 Image quality
 - 6.5.2 Rule of thumb for print size Vs resolution
 - 6.5.3 Device resolution /output resolution
- 6.6 Monitor Resolution
- 6.7 Printer Resolution
- 6.8 Screen frequency
- 6.9 File Size
 - 6.9.1 Bit depth
- 6.10 Scanning Images
 - 6.10.1 Dynamic range, 8 bit, 16 bit and 24 bit colour depth in scanner
 - 6.10.2 36 bits Vs 24 bits
- 6.11 Interpolated Resolution
- 6.12 Graphics file Formats
- 6.13 Summary
- 6.14 Terminal Questions
- 6.15 Answers

6.1 Introduction

Resolution is the term used to describe the number of dots, or pixels, used to display an image. Higher resolutions mean that more pixels are used to create the image, resulting in a crisper, cleaner image. The display, or *resolution* on a monitor, is composed of thousands of pixels or dots. This display is indicated by a number combination, such as 800 x 600. This indicates that there are 800 dots horizontally across the monitor, by 600 lines of dots vertically, equalling 480,000 dots that make up the image you see on the screen.

In other words, resolution is a sharpness and clarity of an image. The term is most often used to describe monitors, printers, and bit-mapped graphic images. In the case of dot-matrix and laser printers, the resolution indicates the number of dots per inch. For example, a 300-dpi (dots per inch) printer is one that is capable of printing 300 distinct dots in a line 1 inch long. This means it can print 90,000 dots per square inch.

For graphics monitors, the screen resolution signifies the number of dots (pixels) on the entire screen. For example, a 640-by-480 pixel screen is capable of displaying 640 distinct dots on each of 480 lines, or about 300,000 pixels. This translates into different dpi measurements depending on the size of the screen. For example, a 15-inch VGA monitor (640x480) displays about 50 dots per inch. Printers, monitors, scanners, and other I/O devices are often classified as high resolution, medium resolution, or low resolution. The actual resolution ranges for each of these grades is constantly shifting as the technology improves.

Objectives:**After studying this unit, you should be able to:**

- Explain image and pixel resolution
- Discuss image classification
- Explain Monitor, Printer resolution and Screen frequency
- Describe Interpolated resolution and Graphic file formats

6.2 Image Resolution

Image resolution is defined as the number of pixels displayed per unit of printed length in an image and is typically measured in pixels per inch (ppi). In computer graphics, pixels are square. In video, pixels are rectangular. This is equivalent to saying that video has different spatial sampling in the horizontal and vertical directions. A square pixel has a pixel aspect ratio or sample aspect ratio (SAR) of 1:1. A non-square pixel has an aspect ratio $W:H$ where W and H are not equal. Higher-resolution images usually reproduce more detail and smoother colour transition than lower-resolution images and when printed. When we apply these resolution concepts to two different graphic formats, vector and bitmap you will find the different output quality.

Vector graphics are resolution-independent – thus, their resolution is determined only by the output device. Because vector elements are mathematically-defined, scaling (enlarging or reducing their size) simply requires modification of their component mathematical descriptions.



Figure 6.1: Vector Graphics

Whereas raster images are resolution-dependent – the number of pixels that occupy a given space must be defined. Consequently, raster image resolution is specified in pixels per inch (ppi). However, although the term is not effective, image resolution commonly is referred to in dots per inch (dpi) – dpi more appropriately is attributed to device resolution or output resolution, where the number of dots an output device is able to produce within an inch represents the resolution of the device.

6.3 Pixel and Resolution

By dividing the number of pixels in the height and in the width of a raster or bitmap by its resolution will determine the physical size of the image - e.g., a 300ppi raster image that is 900 pixels wide and 600 pixels high is 3 inches by 2 inches in size:

$$900 \text{ pixels} \div 300\text{ppi} = 3 \text{ inches wide}$$

$$600 \text{ pixels} \div 300\text{ppi} = 2 \text{ inches high}$$

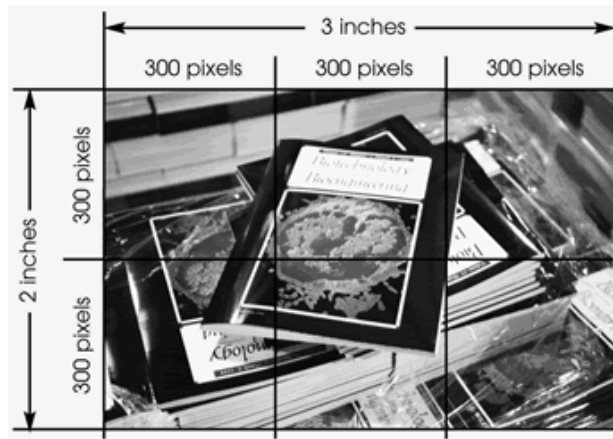


Figure 6.2: Pixel Dimension

Raster images, such as scanned photographs, are made up of small squares called pixels. Image resolution refers to the spacing of pixels in an image and is measured in pixels per inch, ppi, (sometimes called dots per inch, dpi). The higher the resolution, the more pixels in the image. Higher resolution allows for more detail and subtle colour transitions in an image. A printed image that has a low resolution may look pixelated or made up of small squares, with jagged edges and without smoothness.

Image size refers to the physical dimensions of an image. Because the number of pixels in an image is fixed, increasing the size of an image decreases its resolution and decreasing its size increases its resolution.

The typical monitor resolution is 72 dpi. Monitor resolution determines the display size of an image. It is important to realize that a computer monitor is a different medium than a printed magazine or newsletter.

Output resolution refers to the number of dots per inch (dpi) that the output device, such as a laser printer or image setter, produces. Laser printers usually have output resolutions of 300 to 600 dpi. High-end image setters can print at 1200 dpi, 2400 dpi, or higher. The magazines and newsletters are output from the high-end image setters. An image that looks fine from the laser printer may not always look fine from the image setter.

Similarly, a file that looks fine on a monitor when browsing the web, may not be suitable for printing when output from a high-end image setter. Images used for the Internet are kept to a small file size for quicker downloading and

viewing. They are usually at a low resolution, 72 dpi since that is typically the monitor resolution. Resolution matters. Images on the web should not be saved to use for publishing any printed matter. They are usually not the correct image size or resolution.

Resolution refers to the number of pixels in an image. Resolution is sometimes identified by the width and height of the image as well as the total number of pixels in the image. For example, an image that is 2048 pixels wide and 1536 pixels high (2048×1536) contains (multiply) 3,145,728 pixels (or 3.1 Megapixels). You could call it a 2048×1536 or a 3.1 Megapixel image. As the megapixels in the pickup device in your camera increase so does the possible maximum size image you can produce. This means that a 5 megapixel camera is capable of capturing a larger image than a 3 megapixel camera.

6.4 Image Classification

Monochrome (1-bit) - Image resolution for images intended for lithographic print is 900-1200 ppi. In general, monochrome image resolution should be equivalent to the resolution of the intended output device. Output resolution for computer-to-plate devices (i.e., plate setters) typically is about 2400dpi; however, because no significant visible improvement is realized when 2400ppi and 1200ppi monochrome images are compared, the range for monochrome image resolution is suggested as 900-1200ppi.



Figure 6.3: Monochrome Image

Tone image - Resolution is recommended as 300ppi. This recommended resolution, as well as ranges suggested for other file types, assumes that images have been scanned at the same size intended for print (e.g., the typical image width is approximately 20 picas, or 3 1/3 inches, for a single-column image that will appear in a double-column standard size publication).

Combination tone image resolution is recommended as 500-900ppi. Because of text and/or line art components, sufficient resolution is required for combination tones to counter the effect of aliasing (i.e., stair-stepped appearance or "jaggies"); however, higher resolution equates to larger physical file size. Consequently, for combination tones, a compromise is achieved that balances the issues of aliasing and physical file size.

6.5 Image resolution VS Computer Monitor

The computer screen you are looking at right now is set at a particular resolution as well. The larger the screen, the larger you likely have your screen resolution set. If you have a 17" monitor, likely you have it set at 800X600 pixels. If you have a 19" screen it is likely set at 1024X768. You can change the settings but these are optimum for those screen sizes.

Now, if your monitor is set to 800X600 and you open up an image that is 640X480, it will only fill up a part of your screen. If you open up an image that is 2048 X 1536 (3.1 megapixels) then you will find yourself moving the slider bar around to see all the different parts of the image. It just won't fit.

Add to that the fact that the computer monitor has a finite number of **pixels per inch** available (like 72) so if you are going to display your image on a monitor only, you would want to drop the quality down to 72 to save file space. If you are going to put your image on a webpage or email it to a friend then you will want to first make it a useful size. Not too big, not too small. Maybe 200-300 pixels high would be a nice size. You can also reduce the size of the file (not necessarily the size of the image) so it loads faster. You reduce the file size by **compressing** the image (see the next question).

6.5.1 Image quality

In addition to image size, the quality of the image can also be manipulated. Here we use the word "compression". An uncompressed image is saved in

a file format that doesn't compress the pixels in the image at all. Formats such as BMP or TIF files do not compress the image. If you want to reduce the "file size" (number of megabytes required to save the image), you can choose to store your image as a JPG file and choose the amount of compression you want before saving the image.

JPG compression analyzes images in blocks of 8X8 pixels in size and selectively reduces the detail within each block. At higher compression ratios, the block pattern becomes more visible and there may be noticeable loss of detail, especially when you attempt to make prints larger than recommended. The subject and pattern in the image is also a factor. For example, a picture of the blue sky can be compressed quite a bit without any noticeable effects but a picture of a colourful bird would "pixelate" quite quickly.

By using JPG compression, you can keep the physical size of the image the same and reduce the amount of disk space required to store it but you will be sacrificing the quality of the image.

Now, let's work one of these problems backwards. Let's say we want to print an 8×10 picture at 300 dpi. What resolution must we have to do this? 300 times 8 is 2400 and 300 times 10 is 3000. So we would need a 3000×2400 image to do this. Let's see, 3000×2400 is 7.2 megapixels! That would be one very nice digital camera and one very large file, especially if it wasn't compressed.

6.5.2 Rule of thumb for print size Vs resolution

First try to determine what your use for the image will be. Will you want an 8×10 print or will you only be emailing it to a friend? Choose the image size and amount of compression to meet these needs and capture at the least possible compression. The trade off is large file sizes and you will fill up your media quicker but, later on you can dump the original uncompressed image to a CDROM or hard drive, compress the original and resave it with a different file name. You cannot expand a previously compressed file so keep the uncompressed (or low compressed) file as a master. To determine what resolution you will need for particular print sizes, see the chart below.

Table 6.1: Image resolution and print size

Image Resolution	Maximum Print Size
less than 640×480	Wallet size only
640 × 480	absolute largest, 4×6
1024 × 768	4 × 6
1152 × 864	5 × 7
1600 × 1200	8 × 10

6.5.3 Device resolution/output resolution

Ability of device such as scanner, printer, etc. to distinguish detail or to output detail. In the case of input device, e.g. scanner, is the finest detail of workable contrast that can be resolved or discriminated. In the case of output device, e.g. printer, is the highest density or frequency of addressable points that the device is capable of handling.

The number of pixels displayed per unit of printed length in an image, usually measured in pixels per inch (ppi).

Image resolution and pixel dimensions are interdependent. The amount of detail in an image depends on its pixel dimensions; while the image resolution controls how much space the pixels are printed over. For example, we can modify an image's resolution without changing the actual pixel data in the image—all we change is the printed size of the image. However, if we want to maintain the same output dimensions, changing the image's resolution requires a change in the total number of pixels.

Manipal

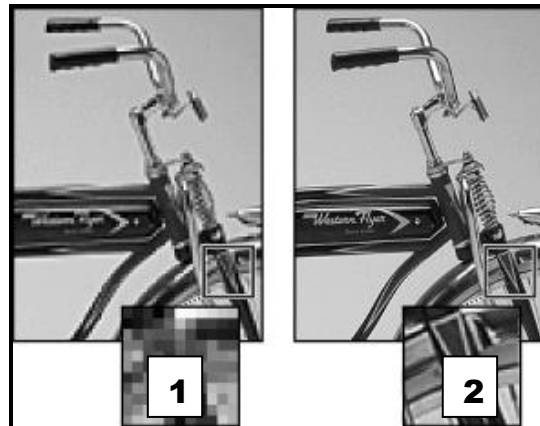


Figure 6.4: The effect of Image resolution.

Left: An image with 72-ppi and same image in zoom 300% - (1)

Right: An image with 300-ppi images the same image zoom 200% - (2)

When printed, an image with high resolution contains more, and therefore smaller pixels than an image with a low resolution. For example, a 1-by-1-inch image with a resolution of 72 ppi contains a total of 5184 pixels (72 pixels wide x 72 pixels high = 5184). The same 1-by-1-inch image with a resolution of 300 ppi contains a total of 90,000 pixels. Higher-resolution images usually reproduce more detail and subtler color transitions than lower-resolution images. However, increasing the resolution of a low-resolution image only spreads the original pixel information across a greater number of pixels; it rarely improves image quality.

Using too low a resolution for a printed image results in *pixilation* - output with large, coarse-looking pixels. Using too high a resolution (pixels smaller than the output device can produce) increases the file size and slows the printing of the image; furthermore, the device will be unable to reproduce the extra detail provided by the higher resolution image.

6.6 Monitor Resolution

The number of pixels or dots displayed per unit of length on the monitor, usually measured in dots per inch (dpi). Monitor resolution depends on the size of the monitor plus its pixel setting. Most new monitors have a resolution of about 96 dpi, while older Mac OS monitors have a resolution of 72 dpi.

Understanding monitor resolution helps to explain why the display size of an image on-screen often differs from its printed size. Image pixels are translated directly into monitor pixels. This means that when the image resolution is higher than the monitor resolution, the image appears larger on-screen than its specified print dimensions. For example, when we display a 1-by-1 inch, 144-ppi image on a 72-dpi monitor, it appears in a 2-by-2 inch area on-screen. Because the monitor can display only 72 pixels per inch, it needs 2 inches to display the 144 pixels that make up one edge of the image.

6.7 Printer Resolution

The number of ink dots per inch (dpi) produced by all laser printers, including image setters. Most desktop laser printers have a resolution of 600 dpi and image setters have a resolution of 1200 dpi or higher. Ink jet printers produce a spray of ink, not actual dots; however, most ink jet printers have an approximate resolution of 300 to 600 dpi and produce good results when printing images up to 150 ppi.

B&W printers do NOT print shades of gray. They use black ink or black toner, and they can print only Black. To simulate gray in graphics, they print halftones. With a magnifying glass, you can see halftones in the images in any book, magazine or newspaper. Halftones are arrays of dots arranged in a grid, say 6x6 or 8x8 to represent each image pixel as a shade of Gray. For dark gray, more grid dots are black. For light gray, more grid dots are white. (More modern methods used for color in magazines vary the size of the dots instead of the ratio of light/dark dots.) The printing graphics software and driver can specify different halftone grid sizes for different effects. For example, a good laser printer might print 600 dpi, or it might print 128 shades of gray, but it cannot do both at the same time. If a larger grid is used, more shades of gray are possible, but less resolution is possible.

Colour printers are similar to B&W printers, in that they must print several of the printer's dots for each image pixel (except for dye sublimation printers, which can make any colour on any printed dot). Inkjets have only 3 or 4 colours of ink, a few have 6 colours, and this is all they can print. They CANNOT print any one of 16 million colours on any one dot. So to represent each image pixel in various colours, shades, and intensities, the image is

dithered, meaning the printer uses a pattern of several of its dots to simulate the colour of each pixel in the image.

For example, to print one "pink" pixel on our inkjets, we know it must mix some red and some white. There is no white ink, white is the bare paper colour, no ink at all. To make red, the printer only has the CMYK (Cyan, Magenta, Yellow, and black) ink colours, and so must use a few magenta and yellow ink dots, not necessarily equal numbers of each, to achieve a certain shade of red. To make lighter shades of red, blank white space is used in the right amount. Black ink dots are used to darken some colours. The average visual effect of all these individual magenta and yellow ink dots, white paper, and sometimes perhaps black ink too, looks pink to us. But all of these multiple ink dots represent or simulate the colour of only one pink image pixel.

So it is clear that we don't get anywhere near 600 or 720 or 1200 or 1440 dpi of "image" resolution from our printers in Colour mode. This requirement for multiple printer dots for one image pixel greatly reduces the printer's real image resolution capability to a fraction of the printer's advertised dpi. Printer specifications are real and accurate and meaningful, but are not to be confused with image resolution. Printer ink dots and image pixels are simply very different things, and one colour image pixel requires many printer ink dots. This is why we need a 1200 dpi printer (ink dots) to print an image at 250 dpi (pixels). And like B&W printers, attempting higher resolutions on colour printers simply limits the pixel size area, allowing fewer ink dots, which then limits to even fewer possible colour tones. We need the several ink dots in that space to simulate the correct colour of the pink image pixel.

Inkjet printers do not use the four CMYK halftone screens from an image setter like commercial printing presses require. We never create CMYK images unless we are doing prepress for an offset ink press. There are unnecessary losses in RGB/CMYK conversion, particularly in the bright colours. Our inkjet printers are designed to expect normal RGB images. Their printer driver expects to convert RGB to CMYK ink, and uses dithering (stochastic with error diffusion) to produce the required colour combinations from the three ink colours.

Dithering - is the use of scattered dots, somewhat randomized instead of ordered halftone grids, which looks smoother on low resolution devices. The printer's limited combinations of three ink colours can rarely make the exact colour for an image pixel. There is usually an error, a difference in the desired colour of the image pixel and what the printer's dots of three colours can do.

Error diffusion - means that the colour error difference is carried over to four adjacent image pixels, one to the right and three below the pixel in error. Those next pixels are intentionally overcompensated in the opposite amount. If the possible dot combination for one pixel is not red enough, the next neighbouring pixels are made overly red, so to speak. Then their own error term is carried over to their neighbours in turn. As this process moves across the image, compensating the colour error, it all balances out and we see the right colour.

Stop and think a second about what you see. Photo quality on an inkjet printer needs images around 250 dpi. However, video screen images are displayed on the monitor at about 75 to 100 ppi apparent size. Yet the video image usually looks better. The big difference is that every RGB phosphor dot on the screen can reproduce any of the 256 intensity values. But a printer's ink dot can only be either present or absent (two values). Inkjets must simulate pixel colours by using combinations of several ink dots of only the four CMYK colours. Inkjet printers are relatively crude devices, and instead of more spatial resolution, what they really need is more colour depth or colour resolution – they need a better way to reproduce the colour of an image pixel in a very small space on paper. They can't use more pixels, smaller pixels simply limit even more their ability to accurately simulate the correct colour of each existing image pixel.

6.7.1 Scale photo images to print at 240 to 300 ppi

This is a good guideline for inkjet printers (1440x720 dpi, 2880x720 dpi, 1200 x 1200 dpi, even 2400 and 4800 dpi) for printing Colour or Greyscale photo images in high quality mode on good photo paper. There is not much benefit from the larger numbers, not when the ink dots are much larger than the grid to hold them.

Line art mode is the exception, being 1-bit 2-color B&W with no gray, no halftones, no dithering. In line art mode, the printer CAN use its full

resolution, because pixels and ink dots can be the same spacing then. Every line art image pixel is either Black or White, and the printer can make black dots without dithering colours. You may want to print 600 dpi line art images, since line art is the exception, the one mode when the printer can use an image resolution equal to the ink dot resolution of the printer.

But for Colour or Greyscale modes, image pixels and printer ink dots are very different concepts. Photo images at 200 to 300 ppi are very appropriate for inkjet printers. Generally about 250 ppi is ideal on photo paper for colour or gray scale. 300 ppi may be slightly better at times, but it will be difficult to see, and even 150 ppi images might sometimes be acceptable, for larger images, or for plain paper.

Graphic images (including images of text) need higher resolution than photo images, probably 300 dpi for commercial work, to maintain sharpness of the hard edges. Line art is best at 600 dpi.

It used to be that the lower inkjet printer dpi rating number divided by 3 or 4 was a very crude approximate range for printed images, but it loses all meaning for today's inflated 2400 and 4800 dpi numbers (the ink dots are simply much larger than these grid locations to hold them).

6.8 Screen Frequency

The number of printer dots or halftone cells per inch used to print grayscale images or color separations. Also known as screen ruling or line screen, screen frequency is measured in lines per inch (lpi) – or lines of cells per inch in a halftone screen.

The relationship between image resolution and screen frequency determines the quality of detail in the printed image. To produce a halftone image of the highest quality, we generally use an image resolution that is from 1.5 to at most 2 times the screen frequency. But with some images and output devices, a lower resolution can produce good results. To determine the printer's screen frequency, check the printer documentation or consult the service provider.

Some image setters and 600-dpi laser printers use screening technologies other than half toning. If we are printing an image on a non-halftone printer,

consult the service provider or the printer documentation for the recommended image resolutions.

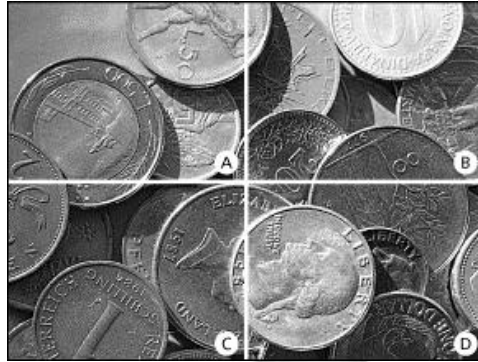


Figure 6.5: The effect of screen frequency on digital image

- A) 65 (line per inch): Coarse screen typically used to print newsletters and grocery coupons.
- B) 85 (line per inch): Average screen typically used to print newspapers.
- C) 133 (line per inch): High-quality screen typically used to print four-color magazines.
- D) 177 (line per inch): Very fine screen typically used for annual reports and images in art books.

6.9 File Size

Image resolution affects the file size in a proportional way. The size of the file is proportional to the square of its resolution. File sizes also depend on the file formats as different compression methods are used by GIF, JPEG and PNG file formats.

Similarly, colour bit-depth and the number of layers and channels in an image also affects file size.

- A graphic seen at an image resolution of 72 dpi having a file size of 95kb
- A graphic seen with the image resolution of 96 dpi having a file size of 168kb
- A graphic seen at an image resolution of 300 dpi having a file size of 1.6 MB

6.9.1 Bit depth

The term "bit depth" is used to describe the number of bits used to store information about each pixel of an image. The higher the depth, the more

colours that are available for storage. The bit depth of an image will determine how many levels of gray (or colour) can be generated.

Bit depth quantifies how many unique colours are available in an image's colour palette in terms of the number of 0's and 1's, or "bits," which are used to specify each colour. This does not mean that the image necessarily uses all of these colours, but that it can instead specify colours with that level of precision. For a grayscale image, the bit depth quantifies how many unique shades are available. Images with higher bit depths can encode more shades or colours since there are more combinations of 0's and 1's available.

Every colour pixel in a digital image is created through some combination of the three primary colours: red, green, and blue. Each primary colour is often referred to as a "colour channel" and can have any range of intensity values specified by its bit depth. The bit depth for each primary colour is termed the "bits per channel." The "bits per pixel" (bpp) refers to the sum of the bits in all three colour channels and represents the total colours available at each pixel. Confusion arises frequently with colour images because it may be unclear whether a posted number refers to the bits per pixel or bits per channel. Using "bpp" as a suffix helps distinguish these two terms.

Most colour images from digital cameras have 8-bits per channel and so they can use a total of eight 0's and 1's. This allows for 2^8 or 256 different combinations – translating into 256 different intensity values for each primary colour. When all three primary colours are combined at each pixel, this allows for as many as $2^{8 \times 3}$ or 16,777,216 different colours, or "true colour." This is referred to as 24 bits per pixel since each pixel is composed of three 8-bit colour channels. The number of colours available for any X-bit image is just 2^X if X refers to the bits per pixel and 2^{3X} if X refers to the bits per channel.

Table 6.2: Table illustrates different image types in terms of bits (bit depth), total colours available, and common names:

Bits Per Pixel	Number of Colours Available	Common Name(s)
1	2	Monochrome
2	4	CGA
4	16	EGA
8	256	VGA
16	65536	XGA, High Colour
24	16777216	SVGA, True Colour
32	16777216 + Transparency	
48	281 Trillion	

6.10 Scanning Images

A scanner's capability to capture dynamic range is governed by the bit depth used and output as well as system performance. The higher the pixels per inch (ppi), the longer it takes to scan the slide. To ensure a high quality scan, you ought to predetermine the scanning resolution and dynamic range required by the image. The scanning resolution should not be greater than the resolution of the display unit, which is usually 640X480 pixels.

When scanning images to be incorporated into a multimedia application, you should usually scan at a resolution between 300 to 600 dpi.

For exporting the scanned image into a multimedia application, you must change its resolution to 72 dpi.

Different types of scanners have different resolution. For example: a flatbed scanner can scan at 300 to 400 dpi. High-end hand scanners offer 600 to 1200 dpi resolutions.

Lowering the resolution while scanning and increasing it later will delete some original colour resolution information and the resulting image will not be as sharp as the original.

6.10.1 Dynamic range, 8 bit, 16 bit and 24 bit colour depth in scanner

The first thing to remember is that bit depth and dynamic range are not the same thing. It is going to sound much the same, but it's not. 36 bit scanners

with good dynamic range can sometimes capture more shadow detail from an image than can a 30 bit scanner. Specifically, dynamic range may add more detail in the shadow tones of images from positive film (slides), and in the highlights of images from negative film.

Dynamic range is not a major consideration for scanning photo prints, because prints themselves are very limited, but it is very important when scanning film. We'll try to explain how it helps, because it's the subject of many incorrect myths.

All scanners are at least 36 bits now, and most are 42 or 48 bits. More bits support more dynamic range, but does not ensure it exists. More bits are required to hold numeric values containing better dynamic range, but this one detail does not ensure it. While the two factors are often associated, there is also a second requirement. High-quality low-noise CCD and electronics (i.e., expensive) are needed for better dynamic range. The trend today is that inexpensive scanners are offering 48 bit A/D conversion (analog to digital), which just means that inexpensive A/D chips are available now.

Image density is measured from image brightness with optical densimeters, and ranges from 0 to 4, where 0 is pure white and 4 is very black. More density is less brightness. Density is measured on a logarithmic scale (similar to the Richter scale for earthquakes). Density of 3.0 is 10 times greater intensity than a density of 2.0. An intensity range of 100:1 is a density range of 2.0, and 1000:1 is a range of 3.0. Density 4.0 is not a theoretical maximum, the math is not limited, but it is a practical maximum of density, because nothing you can scan will reach 4.0.

The minimum and maximum values of density capable of being captured by a specific scanner are called DMin and DMax. If the scanner's DMin were 0.2 and DMax were 3.1, its Dynamic Range would be 2.9. DMax implies unique image tone values are distinguishable, and not hidden by electronic noise. Greater dynamic range can detect greater image detail in dark shadow areas of the photographic image, because the range is extended at the black end.

When I say the "black end", I speak of positives, either prints or slides. When images from negatives are reversed, this effect transfers to the

highlight tones. Most literature about 30 or 36 bits just says it improves "shadows and highlights" without making this distinction.

A printed magazine image has a dynamic range well less than 2.0, maybe half of that (1.7). The blackest ink still reflects some light, the white paper is not so bright that it blinds us, and the difference is relatively small. Photographic colour prints have a dynamic range of less than 2.0 too. Film negatives might have a range up near 2.8. Slides may be near 3.2. These are not precise numbers.

Slides have less photographic range than negatives. Slides have perhaps about 5 or 6 f-stops of total scenic range, compared to perhaps 9 or 10 f-stops for negatives. Expose a slide half a stop off and the results are objectionable.

But slide film itself has more contrast, a steeper gamma curve, and while the captured scenic tonal range may be less, the density extremes on the film can be greater. The extremes of slides are more likely to be clear or black, and contain greater dynamic range as seen at the scanner. Colour negative film has the orange mask (helps reversal colour balance) which also limits DMin and the overall scanning range. Images from negatives invert dark noise to be in the highlights, less noticeable there. Slides are more difficult than negatives to capture the shadow detail, and slides need a film scanner with greater dynamic range.

24 bit scanners might have a dynamic range specifications near 2.4, needed for photo prints. 30 bit scanners might be near 3.0, needed for negatives. The best 36 bit scanners might approach 3.6, better for slides. For sure, they can't be more. Only rotating drum scanners can approach 4.0 (these use Photo Multiplier Tubes, (PMT), extremely expensive) and of course, all scanners are not equal, some will have higher dynamic range than others because their electronics have less noise. Price is definitely a factor.

The greater dynamic range extends the signal into low black levels where the noise is. To be effective, the electronics must be improved greatly to reduce the noise. The hardest problem for the scanner is the black end, density values beyond 3.0. One good reason is low level signal and noise.

6.10.2 36 bits Vs 24 bits

24 bit colour is three 8-bit bytes, one byte for each of the Red, Green, and Blue CCD channels, to describe the colour of each pixel in the image. 30 bit colour uses 10 bits for each of the three primary RGB colours. In binary numbers, each bit is a power of 2, meaning that each additional bit doubles the maximum size of the numbers that can be stored. Same concept in decimal numbers using powers of 10, each digit there allows numbers 10 times larger to be represented.

Scanners detect light intensity corresponding to the density of the original. More film density lets less light come through, or more print density reflects less light. The CCD sensor measures that resulting light intensity. The image RGB numbers stored are proportional to intensity values in the original.

Basically the human eye responds to brightness in a logarithmic manner. The human eye does not perceive twice the intensity as being twice as bright. For a common example, photographers use their light meters on a "standard gray card" made to reflect 18% of the light falling on it. Metering from that card is used to calibrate middle gray (50% to our eye) in the hypothetical "average" scene. We see that 18% intensity as apparent 50% brightness.

The 12 bit scanner divides the scanned density range into smaller steps, 4096 steps in 12 bits instead of 256 steps in 8 bits, and therefore can show slightly more unique detail in the shadow areas, for a couple of reasons. Tiny variations that might be the same one colour value at 8 bits could be 4 slightly different shades at 10 bits, or 16 slightly different shades at 12 bits, or 64 slightly different shades at 14 bits. Tiny differences, and it is really only significant at the black end, but that's more detail and the possibility of larger numbers provides an opportunity for a better CCD to extend the dynamic range a little way into the next "10 times" logarithmic density interval. The better CCD is required to capture this detail in the darkest film, and more bits are required to store the numbers representing more range.

6.11 Interpolated Resolution

An enhanced resolution of a scanning device that is computed using a software algorithm. Also called the "digital resolution," it makes an image

appear as if it were scanned at a higher resolution. An interpolated resolution is considerably greater than the optical resolution, which is the inherent physical resolution of the device. Depending on the contents of the image and the scanning algorithm, an interpolated, or enhanced, resolution can improve or degrade the original.

Interpolated resolution measures how many pixels the scanner can scan at. Through a process called interpolation, the scanner turns a 300 X 300 dpi scan into a 600 X 600 dpi scan by inserting new pixels in between the old ones, and guessing at what light reading it would have sampled in that spot had it been there. This process almost diminishes the quality of the scan and therefore it should always be avoided. This is only useful to scan line art at very high resolution. Line art is any black and white or single colour graphic, such as a logo, ink sketch, or mechanical blueprint. For this, set the resolution equal to that of the output device. When producing line art to be printed by a 1200 dpi image setting, set the interpolated resolution up to about 1200 dpi for superior quality.



Figure 6.6: showing an image scanned at 33 dpi



Figure 6.7: showing an image scanned at 100 dpi



Figure 6.8: showing an image scanned at 200 dpi



Figure 6.9: Showing an image scanned at 300 dpi



Figure 6.10: showing an image scanned at 600 dpi

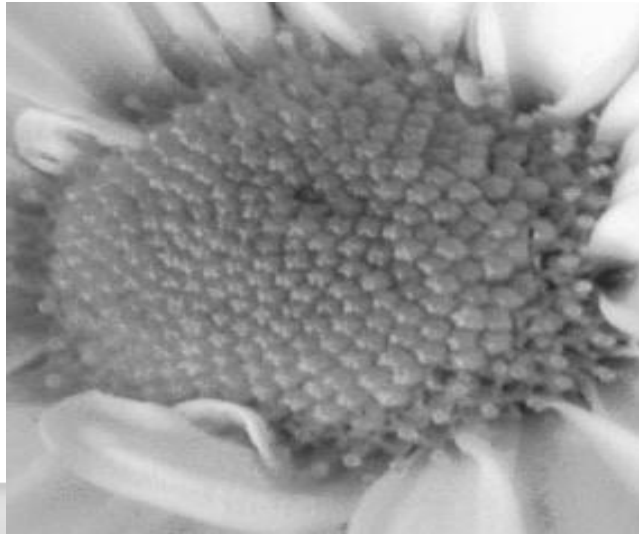


Figure 6.11: showing an image scanned at 1200 dpi

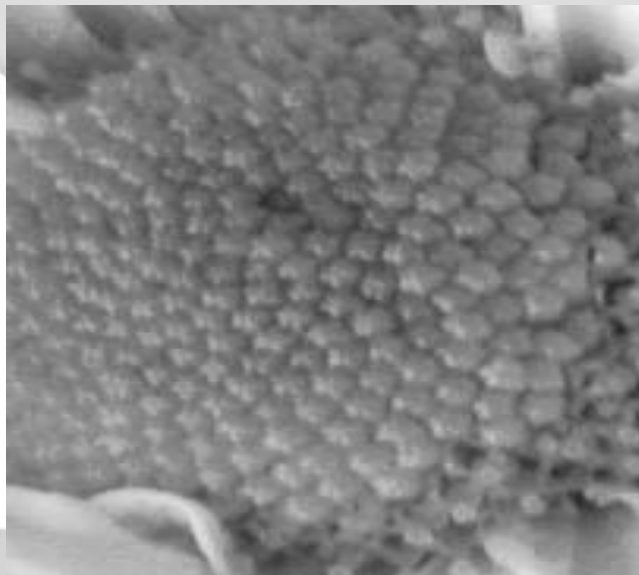


Figure 6.12: showing an image scanned at 2400 dpi

6.12 Graphics File Formats

The file format for master images should support the resolution, bit-depth, colour information, and metadata you need. For example, there is little

sense in creating a full colour image, only to save it in a format that cannot support more than 8 bits (e.g., GIF).

The format should also handle being stored uncompressed or compressed using either lossless or lossy techniques. It should be open and well documented, widely supported, and cross-platform compatible. Although there is interest in other formats, such as PNG, SPIFF, and Flashpix, most cultural institutions rely on TIFF to store their master images.

Self Assessment Questions

1. _____ is the term used to describe the number of dots, or pixels, used to display an image.
2. Raster images, such as scanned photographs, are made up of small squares called _____
3. JPG compression analyzes images in blocks of _____ pixels in size and selectively reduces the detail within each block.
4. The number of pixels or dots displayed per unit of length on the monitor, usually measured in _____
5. The term _____ is used to describe the number of bits used to store information about each pixel of an image.

6.13 Summary

- Image resolution is the number of pixels displayed per unit of printed length in an image and is typically measured in pixels per inch (ppi).
- The higher the image resolution, the more disk space the image requires, and consequently the more time it will take to be displayed, and longer to print.
- Device or output resolution refers to the number of pixels or dots per inch (dpi) that an output device such as a monitor, an LCD panel or a video/data projector can produce.
- Printer resolution refers to the number of ink dots per inch (dpi) produced by all laser printers, including the image setters.
- Digital Images are electronic snapshots taken of a scene or scanned from documents, such as photographs, manuscripts, printed texts, and artwork.
- Interpolated resolution is resolution enhanced through software, and is useful for certain tasks like scanning line art or enlarging small originals.

6.14 Terminal Questions

1. What is image resolution?
2. What is the difference between pixel and resolution?
3. How do you differentiate monitor and printer resolution?
4. What is file size? Briefly explain bit depth.

6.15 Answers**Self Assessment Questions**

1. Resolution
2. Pixels
3. 8 X 8
4. Dots per inch
5. Bit depth

Terminal Questions

1. Image resolution is defined as the number of pixels displayed per unit of printed length in an image and is typically measured in pixels per inch (ppi).
(Refer section 6.2)
2. Raster images, such as scanned photographs, are made up of small squares called pixels. (Refer section 6.3)
3. Monitor resolution depends on the size of the monitor plus its pixel setting. Most new monitors have a resolution of about 96 dpi, while older Mac OS monitors have a resolution of 72 dpi. The number of ink dots per inch (dpi) produced by all laser printers, including image setters. (Refer section 6.6)
4. Image resolution affects the file size in a proportional way. Bit depth" is used to describe the number of bits used to store information about each pixel of an image.
(Refer section 6.9)

Unit 7

Graphic Image files formats

Structure

- 7.1 Introduction
 - Objectives
- 7.2 Graphic file formats
 - 7.2.1 GIF (Graphic Interchange Format)
 - 7.2.2 JPEG (Joint Photographic Experts Group)
 - 7.2.3 PNG (Portable Network Graphics)
 - 7.2.4 BMP
 - 7.2.5 PDF
 - 7.2.6 TIFF
 - 7.2.7 PICT Resource
 - 7.2.8 PIXAR
 - 7.2.9 Photoshop Format
 - 7.2.10 Photoshop 2.0 (Photoshop)
 - 7.2.11 AVI (ImageReady)
 - 7.2.12 Photoshop EPS
 - 7.2.13 EPS TIFF or EPS PICT Preview
 - 7.2.14 Filmstrip
 - 7.2.15 PCX
 - 7.2.16 PICT File
 - 7.2.17 QuickTime Movie (ImageReady)
 - 7.2.18 Raw (Photoshop)
 - 7.2.19 Scitex CT (Photoshop)
 - 7.2.20 Targa
- 7.3 Converting Formats
- 7.4 Compressing Data
- 7.5 Summary
- 7.6 Terminal Questions
- 7.7 Answers

7.1 Introduction

Anyone using a computer should be familiar with the concept of **file formats**. File formats help to identify what kind of file is being worked with and are usually distinguished by the file extension. Most computer

applications have a **native file format**, i.e., a default format for files created in that program. (For example, by default, Adobe Photoshop saves files with an .PSD extension, while Adobe Illustrator saves files with an .ai extension.) In addition, many applications allow the user to save files in formats other than the application's native format. It is a good idea to save files in the native format in addition to any desired non-native format.

There are three primary **graphic file formats** for Web images: **GIF** (Graphic Interchange Format), **JPEG** (Joint Photographic Experts Group), and **PNG** (Portable Network Graphics). Each of these graphic file formats is cross-platform and uses some form of compression to be optimized for use on the Web.

Objectives:

After studying this unit, you should be able to:

- Describe various graphic file formats
- Explain conversion techniques
- Explain compressing data

7.2 Graphic File Formats

The specific format in which an image file 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 bits per pixel and additional information.

7.2.1 GIF (Graphic Interchange Format)

Graphics Interchange Format (GIF) is the file format commonly used to display indexed-color graphics and images in hypertext markup language (HTML) documents over the World Wide Web and other online services. GIF is an LZW-compressed format designed to minimize file size and electronic transfer time. GIF format preserves transparency in indexed-color images; however, it does not support alpha channels.

GIF is the preferred file format for images with large areas of solid color, such as logos, text as graphics, cartoons, etc. The GIF file format supports 8-bit images (up to 256 colors).

Here are some other important features of GIF images:

1. GIFs use a lossless compression scheme, i.e., images do not lose data when compressed and, therefore, don't lose image quality.
2. GIF 8-bit images allow for one transparent color.
3. GIF interlaced images can be displayed as low-resolution images initially and then develop clarity and detail gradually.
4. GIF images can be used to create simple animations.
5. GIFs are saved with a .gif extension.

7.2.2 JPEG (Joint Photographic Experts Group)

Joint Photographic Experts Group (JPEG) format is commonly used to display photographs and other continuous-tone images in hypertext markup language (HTML) documents over the World Wide Web and other online services. JPEG format supports CMYK, RGB, and Grayscale color modes, and does not support alpha channels. Unlike GIF format, JPEG retains all color information in an RGB image but compresses file size by selectively discarding data.

A JPEG image is automatically decompressed when opened. A higher level of compression results in lower image quality, and a lower level of compression results in better image quality. In most cases, the Maximum quality option produces a result indistinguishable from the original.

JPEG is the preferred file format for photographic images. In addition, the JPEG format works well with subtle transitions in color, such as watercolors, pencil or charcoal drawings, etc. The JPEG file format supports 24-bit images (over 16 million colors).

Here are some other important features of JPEG images:

1. JPEGs use a lossy compression scheme; data is removed from the image to make the file size smaller when compressed.
2. JPEG images allow for various compression levels, providing for the adjustment of compression to best display the image without losing too much of the image quality. Due to the various compression levels, it is suggested that the original image be saved and used for editing purposes; don't edit a JPEG image that has been compressed.
3. JPEG images are not interlaced; however, progressive JPEG images can be interlaced.
4. JPEGs are saved with a .jpeg or .jpg extension.

7.2.3 PNG (Portable Network Graphics)

Developed as a patent-free alternative to GIF, Portable Network Graphics (PNG) format is used for lossless compression and for display of images on the World Wide Web. Unlike GIF, PNG supports 24-bit images and produces background transparency without jagged edges; however, some Web browsers do not support PNG images. PNG format supports RGB, indexed-color, grayscale, and Bitmap-mode images without alpha channels. PNG preserves transparency in grayscale and RGB images.

PNG is a relatively new image file format that has many advantages over GIF and JPEG. The PNG file format can be 24-bit or 8-bit, eliminating some of the limitations of the other formats.

Here are some other important features of PNG images:

1. PNG images use a lossless compression scheme.
2. PNG images are interlaced.
3. PNG images support 8-bit transparency.
4. PNG images include the ability to correct for gamma information based on the computer monitor on which they are being viewed.
5. PNGs are saved with a .png extension.

7.2.4 BMP

BMP is a standard Windows image format on DOS and Windows-compatible computers. BMP format supports RGB, Indexed Color, Grayscale, and Bitmap color modes, and does not support alpha channels. We can specify either Microsoft(r) Windows or OS/2(r) format and a bit depth for the image. For 4-bit and 8-bit images using Windows format, we can also specify RLE compression.

7.2.5 PDF

Portable Document Format (PDF) is a flexible, cross-platform, cross-application file format. Based on the PostScript imaging model, PDF files accurately display and preserve fonts, page layouts, and both vector and bitmap graphics. In addition, PDF files can contain electronic document search and navigation features such as electronic links.

Photoshop and Image Ready, Corel Draw recognize two types of PDF files: Photoshop PDF files and Generic PDF files. We can open both types of PDF files; however, we can only save images to Photoshop PDF format.

Photoshop PDF files are created using the Photoshop Save As command. Photoshop PDF files can contain only a single image.

Photoshop PDF format supports all of the color modes and features that are supported in standard Photoshop format. Photoshop PDF also supports PEG and ZIP compression, except for Bitmap-mode images, which use CCITT Group 4 compression.

Generic PDF files are created using applications other than Photoshop, such as Adobe Acrobat and Adobe Illustrator, and can contain multiple pages and images. When we open a Generic PDF file, Photoshop rasterizes the image.

7.2.6 TIFF

Tagged-Image File Format (TIFF) is used to exchange files between applications and computer platforms. TIFF is a flexible bitmap image format supported by virtually all paint, image-editing, and page-layout applications. Also, virtually all desktop scanners can produce TIFF images.

TIFF format supports CMYK, RGB, Lab, indexed-color, and grayscale images with alpha channels and Bitmap-mode images without alpha channels. Photoshop can save layers in a TIFF file; however, if we open the file in another application, only the flattened image is visible. Photoshop can also save annotations, transparency, and multiresolution pyramid data in TIFF format.

7.2.7 PICT Resource

A PICT resource is a PICT file contained in a Mac OS file's resource for example, an applications' splash screen or the contents of the Scrapbook. PICT Resource format supports RGB images with a single alpha channel, and indexed-color, grayscale, and Bitmap-mode images without alpha channels.

We can use the Import command or the Open command to open a PICT resource. When saving a file as a PICT resource, we can specify the resource ID and resource name. As with other PICT files, we also specify bit depth and compression options.

7.2.8 PIXAR

PIXAR format is designed specifically for exchanging files with PIXAR image computers. PIXAR workstations are designed for high-end graphics applications, such as those used for three-dimensional images and animation. PIXAR format supports RGB and grayscale images with a single alpha channel.

7.2.9 Photoshop Format

Photoshop format (PSD) is the default file format for newly created images and the only format supporting all available image modes (Bitmap, Grayscale, Duotone, Indexed Color, RGB, CMYK, Lab, and Multichannel), guides, alpha channels, spot channels, and layers (including adjustment layers, type layers, and layer effects).

If we edit or save an image using an earlier version of Photoshop, unsupported features are discarded. Keep in mind the following features when working with earlier versions of Photoshop:

Layer sets, layer color coding, layer clipping paths, fill layers, and layer styles are new in Photoshop 6.0. Layer effects were introduced in Photoshop 5.0; however, these effects do not cover the full range of layer effects provided by Photoshop 6.0. Adjustment layers were introduced in Photoshop 4.0. Paragraph type and advanced type formatting are new in Photoshop 6.0. If we open a Photoshop 6.0 file containing type in Photoshop 5.0 or Photoshop 5.5, the type is displayed in raster form. This means that we can change attributes of the type layer, but we can't edit the text. Color samplers, spot channels, and embedded ICC profiles were introduced in Photoshop 5.0. Guides were introduced in Photoshop 4.0.

7.2.10 Photoshop 2.0 (Photoshop)

We can use this format to open an image in version 2.0 or to export an image to an application supporting only Photoshop 2.0 files. Saving in Photoshop 2.0 format flattens the image and discards layer information.

7.2.11 AVI (ImageReady)

(Windows) Audio Video Interleave (AVI) format is the standard Windows format for audio/video data. In Windows, AVI format is visible in the Files of Type pop-up menu only when QuickTime is installed on the computer.

7.2.12 Photoshop EPS

Encapsulated PostScript (EPS) language file format can contain both vector and bitmap graphics and is supported by virtually all graphic, illustration, and page-layout programs. EPS format is used to transfer PostScript-language artwork between applications. When we open an EPS file containing vector graphics, Photoshop rasterizes the image, converting the vector graphics to pixels.

EPS format supports Lab, CMYK, RGB, Indexed Color, Duotone, Grayscale, and Bitmap color modes, and does not support alpha channels. EPS does support clipping paths. In Desktop Color Separations (DCS) format, a version of the standard EPS format, we can save color separations of CMYK images. We use DCS 2.0 format to export images containing spot channels. To print EPS files, we must use a PostScript printer.

7.2.13 EPS TIFF or EPS PICT Preview (Photoshop)

These formats let us to open images saved in file formats that create previews but are not supported by Adobe Photoshop (such as QuarkXPress(r)). An opened preview image can be edited and used like any other low-resolution file. EPS PICT Preview is available only in Mac OS.

Note: EPS TIFF format and EPS PICT format were more relevant for use in earlier versions of Photoshop. The current version of Photoshop includes rasterization features for opening files that include vector data.

7.2.14 Filmstrip

Filmstrip format is used for RGB animation or movie files created by Adobe - Premiere(r). If we resize, resample, remove alpha channels, or change the color mode or file format of a Filmstrip file in Photoshop, we won't be able to save it back to Filmstrip format.

7.2.15 PCX

PCX format is commonly used by IBM PC-compatible computers. Most PC software supports version 5 of PCX format. A standard VGA color palette is used with version 3 files, which do not support custom color palettes.

PCX format supports RGB, Indexed Color, Grayscale, and Bitmap color modes, and does not support alpha channels. PCX supports the RLE compression method. Images can have a bit depth of 1, 4, 8, or 24.

7.2.16 PICT File

PICT format is widely used among Mac OS graphics and page-layout applications as an intermediary file format for transferring images between applications. PICT format supports RGB images with a single alpha channel, and indexed-color, grayscale, and Bitmap-mode images without alpha channels. PICT format is especially effective at compressing images with large areas of solid color. This compression can be dramatic for alpha channels with their large areas of white and black.

When saving an RGB image in PICT format, we can choose either a 16-bit or 32-bit pixel resolution. For a grayscale image, we can choose from 2, 4, or 8 bits per pixel. In Mac OS with QuickTime installed, four JPEG compression options are available.

Note: In ImageReady, PICT format is supported in Mac OS only.

7.2.17 QuickTime Movie (ImageReady)

QuickTime Movie format is a cross-platform format used for time-based data, such as video and audio. In ImageReady, we can save animations as QuickTime movies and open existing QuickTime movies as animations in order to optimize them for the Web.

Note: In Windows, QuickTime Movie format is visible in the Files of Type pop-up menu only when QuickTime is installed on the computer.

7.2.18 Raw (Photoshop)

Raw format is a flexible file format for transferring images between applications and computer platforms. This format supports CMYK, RGB, and grayscale images with alpha channels, and multichannel and Lab images without alpha channels.

Raw format consists of a stream of bytes describing the color information in the image. Each pixel is described in binary format, with 0 representing black and 255 white (for images with 16-bit channels, the white value is 65535). Adobe Photoshop designates the number of channels needed to describe the image, plus any additional channels in the image. We can specify the file extension.

The header parameter specifies how many bytes of information appear in the file before actual image information begins. This value determines the number of zeroes inserted at the beginning of the file as placeholders. By

default, there is no header (header size = 0). We can enter a header when we open the file in Raw format. We can also save the file without a header and then use a file-editing program, such as HEdit to replace the zeros with header information.

We can save the image in an interleaved or noninterleaved format. If we choose interleaved, the color values (red, green, and blue, for example) are stored sequentially.

7.2.19 Scitex CT (Photoshop)

Scitex Continuous Tone (CT) format is used for high-end image processing on Scitex computers. Contact Scitex to obtain utilities for transferring files saved in Scitex CT format to a Scitex system. Scitex CT format supports CMYK, RGB, and grayscale images and does not support alpha channels.

CMYK images saved in Scitex CT format often have extremely large file sizes. These files are generated for input using a Scitex scanner. Images saved in Scitex CT format are printed to film using a Scitex rasterizing unit, which produces separations using a patented Scitex halftoning system. This system produces very few moiré patterns and is often demanded in professional color work—for example, ads in magazines.

7.2.20 Targa

TGA (Targa(r)) format is designed for systems using the Truevision(r) video board and is commonly supported by MS-DOS color applications. Targa format supports 24-bit RGB images (8 bits x 3 color channels) and 32-bit RGB images (8 bits x 3 color channels plus a single 8-bit alpha channel). Targa format also supports indexed-color and grayscale images without alpha channels. When saving an RGB image in this format, we can choose a pixel depth.

7.3 Converting Formats

Not all image formats are compatible with one another. You can always convert between bitmap formats and from vector to bitmap. There are various file converters. The Microsoft paint program that comes with windows can convert between BMP, JPEG and GIF formats. To convert a bitmap to vector, you need special software called tracing softwares. CorelDraw, Xara, Freehand, Flash and many other drawing applications come bundled with autotracing utilities.

7.4 Compressing Data

Data compression means storing data in a format that requires less space than usual. It is very useful because it enables devices to transfer the same amount of data in fewer bits. Data compression is widely used in backup utilities, spreadsheet applications and database small fraction of their normal size.

There are two types of compression namely lossless and lossy. Lossless preserve the exact image throughout the compression and decompression process, but the resulting file can be very large. Lossy compression actually eliminates some of the data in the image and, therefore, provides greater compression ratios than lossless compression.

But greater the compression ratio, poorer will be the quality of the decompressed image. The common compressed image file formats are JPEG, BMP, PNG, GIF and XBM.

The following table lists the file formats and software that handle compression:

.gif	Graphics compression format from CompuServe most suitable for line-art images.	Viewable with web browser or Lview Pro (PC) or Gif Converter (Mac).
.jpeg	Compression standard particularly suitable for photographic images.	Viewable with graphical web browser, also Lview Pro and PolyView.
.png	PNG (Portable Network Graphics) is an extensible file format for faster images intended as a patent-free replacement for the GIF format.	Supported by Internet Explorer 4.
.tiff	High-resolution image format	JPEGView (Mac) Lview Pro (PC)

Self Assessment Questions

- 1) Three primary graphic file formats for Web are _____
- 2) GIF stands for _____
- 3) _____ image is automatically decompressed when opened.
- 4) _____ format is used for lossless compression and for display of images on the World Wide Web.
- 5) _____ is used to exchange files between applications and computer platforms.
- 6) _____ format is commonly used by IBM PC-compatible computers.
- 7) _____ means storing data in a format that requires less space than usual.

7.5 Summary

- Image resolution is the number of pixels displayed per unit of printed length in an image and is typically measured in pixels per inch (ppi).
- The higher the image resolution, the more disk space the image requires, and consequently the more time it will take to be displayed, and longer to print.

7.6 Terminal Questions

1. Briefly explain graphic file formats.
2. What is JPEG? Explain its features.
3. How PDF is useful in document creations?
4. What is Photoshop format?

7.7 Answers**Self Assessment Questions**

1. GIF, JPEG and PNG
2. Graphic Interchange Format
3. JPEG
4. PNG
5. TIFF
6. PCX
7. Data compression

Terminal Questions

1. There are three primary graphic file formats for Web images: GIF (Graphic Interchange Format), JPEG (Joint Photographic Experts Group), and PNG (Portable Network Graphics). (Refer section 7.2)
2. Joint Photographic Experts Group (JPEG) format is commonly used to display photographs and other continuous-tone images in hypertext markup language (HTML) documents over the World Wide Web and other online services. (Refer section 7.2.2)
3. Portable Document Format (PDF) is a flexible, cross-platform, cross-application file format. (Refer section 7.2.5)
4. Photoshop format (PSD) is the default file format for newly created images. (Refer section 7.2.9)



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