UNIT: 1 COMPUTER GRAPHICS &MULTIMEDIA

1. GRAPHICS:

Graphics is the visual and pictorial representation of any object according to the idea and imagination of the developer or designer. Graphic is an art of the science drawing. Graphics design is a creative process that most often evolving a client and designer. Graphics is the most important tool for displaying results after processing the data which is given by a user. Graphics is that system which produce the results in pictorial form for better easily understand. When a user provides some inputs to the system for processing then system will give results in the form of images or in the form of Graphics. Graphics provides us interface between the user and hardware. When a user is performs his task by using any application program in the computer then produced the result of those operations after processing which are shown to the screen in Graphics form. Everything which you saw on the display screen is called as Graphics. A Graphics may a single picture, multiple pictures, any box etc. Graphics are always made through as inputs provided by user. Every Input of a user will cause the output or display of the picture.

The term computer graphics has been used in a broad sense to describe "almost everything on computers that are not text or sound". Typically, the term **computer graphics** refers to several different things:

- The representation and manipulation of pictorial data by a computer.
- The various technologies used to create and manipulate such pictorial data.
- The sub-field of computer science which studies methods for digitally synthesizing and manipulating visual content.

2. COMPUTER GRAPHICS:

Computer graphics is the branch of science and technology concerned with methods and techniques for converting data to or from visual presentation using computers. Computer graphics is concerned with producing images and animations (or sequences of images) using a computer. This includes the hardware and software systems used to make these images. The task of producing photo-realistic images is an extremely complex one, but this is a field that is in great demand because of the nearly limitless variety of applications. The field of computer graphics has grown enormously over the past 10–20 years, and many software systems have been developed for generating computer graphics of various sorts. This can include systems for producing 3-dimensional models of the scene to be drawn, the rendering software for drawing the images, and the associated user interface software and hardware.

Computer graphics is an art of drawing images and objects according to mathematical laws and rules as in perspective projection and the interest. Computer graphics is a method to display our creations in pictorial mode. "Computer Graphics is a subject to investigate graphics representation, generation, processing and display by using Computers". Computer Graphics is one of the most active branch in computer science. Today computers and computer graphics are an internal part of daily life for everybody. Computer graphics has a great impact on today's technology. Computer graphics is in daily use in the fields of science, engineering, medicine, entertainment, advertisement, the graphic arts, the fine arts, business, education and training to mention any idea. With the help of it, we can represent and generate the model of every ideas or imaginations. So, computer graphics are graphical representation and manipulation of image data created using computers. Computer Graphics is the use of computer to define, store, manipulate, interrogate, and present pictorial output.

Computer graphics is a complex and diversified technology. Computer graphics represents finally, a picture or image where the picture may be used for a large variety of purposes like : it may be an engineering drawing, a business graph, an architectural rendering for a proposed constructions or design project, an image for a medical procedure or a single frame for an animated movie. It is the generation of graphical output using computer which includes the creation, storage and manipulation of image of objects. Computer graphics is the most important and easy method for represent our though in to image or picture mode. We can design the model of every idea of every field in graphical shape and show and see that easily. Computer graphics provides methods to generate images using a computer. An image can represent a realistic scene from the real world, but graphics like histograms or pie charts as well as the graphical user interface of a software tool are also considered as images.

The development of computer graphics has made computers easier to interact with, and better for understanding and interpreting many types of data. Developments in computer graphics have had a profound impact on many types of media and have revolutionized animation, movies and the video game industry. "A picture is worth a thousand words" is a well-known saying, and highlights the

advantages and benefits of the visual presentation of our data. The picture is the fundamental cohesive concept in the computer graphics. Computer imagery is found on television, in newspapers, for example in weather reports, or for example in all kinds of medical investigation and surgical procedures. A well-constructed graph can present complex statistics in a form that is easier to understand and interpret. In the media "such graphs are used to illustrate papers, reports, theses, and other presentation material". So, computer graphics has become an essential part of today's technology. It is the life line of today's computer world. Today, computers and computer-generated images touch many aspects of daily life. Many powerful tools have been developed to visualize data. Computer generated imagery can be categorized into several different types: 2D, 3D, 5D, and animated graphics. As technology has improved, 3D computer graphics have become more common, but 2D computer graphics are still widely used. Computer graphics has emerged as a sub-field of computer science which studies methods for digitally synthesizing and manipulating visual content. Over the past decade, other specialized fields have been developed like information visualization and scientific visualization more concerned with "the visualization of three dimensional phenomena like architectural, meteorological, medical, biological etc. , where the emphasis is on realistic renderings of volumes, surfaces, illumination sources, and so forth, perhaps with a dynamic (time) component".

3. SOME COMPUTER GRAPHICS TERMS:

Interactive Graphics:

The word interactive graphics means the set of technologies used to create art with computers or the art or designs created using such technologies. Generally a Graphics is shown by user when he requests for some applications program. Interactive graphics is a computer graphics system that allows the operator or user to interact with the graphical information presented on the display using one or more of a number of input devices, some of which are aimed at delivering positions relevant to the information being displayed. Almost all computer workstations and personal computer systems are now able to be used interactively. Interactive computer Graphics like a website, it is only useful if it is browsed by a visitor and no two visitors are exactly alike. It means the website must support the interaction of users with a variety of skills, interests and end goals. Interactive computer graphics involves the user's interaction. Interactive computer Graphics like a website, it is only useful if it is browsed by a visitor and no two visitors are exactly alike. It means the website must support the interaction of users with a variety of skills, interests and end goals. Interactive computer graphics involves the user's interaction.

An interactive Graphics provides a facility to represent any Graphics. Interactive Graphics are those which are made by user, means all the attributes of a Graphics are depend upon the user input. Application model provides these features for changing display of a Graphics and many times a programmer wants to make his Graphics according to his needs and a programmer may also creates or changes or modifies any Graphics. Application Models those are also called as Geometric and Non-Geometric Graphics and also some directed Graphs those are used for displaying objects in Graphical form. In Geometric form like Labels, Boxes, and Lines etc. and in Non-Geometric Graphics include some textual information and also some numeric data or a user inputs.

Interactive Computer graphics are graphics created using computer and, the representation and manipulation of image data by a computer. The development of computer graphics, has made computers easier to interact with, and better for understanding and interpreting many types of data. Developments in computer graphics have had a profound impact on many types of media and have revolutionized animation, movies and the video game industry.

2D Computer Graphics:

2D computer graphics are the computer-based generation of digital images mostly from two-dimensional models, such as 2D geometric models, text and digital images. The word may stand for the branch of computer science that comprises such techniques, or for the models themselves.

2D computer graphics are mainly used in applications that were originally developed upon traditional printing and drawing technologies, such as typography, cartography, technical drawing, advertising etc. In those applications, the two-dimensional image is not just a representation of a real-world object, but an independent artefact with added semantic value; two-dimensional models are therefore preferred, because they give more direct control of the image than 3D computer graphics, whose approach is more related to photography than to typography.

3D Computer Graphics:

3D computer graphics in contrast to 2D computer graphics are graphics that use a three-dimensional representation of geometric data that is stored in the computer for the purposes of performing calculations and rendering 2D images. Such images may be for later display or for real-time viewing. Despite these differences, 3D computer graphics rely on many of the same algorithms as 2D computer vector graphics in the wire frame model and 2D computer raster graphics in the final rendered display. In computer graphics software, the distinction between 2D and 3D is occasionally blurred; 2D applications may use 3D techniques to achieve effects such as lighting, and primarily 3D may use 2D rendering techniques.

4. HISTORY OF COMPUTER GRAPHICS:

We need to take a brief look at the historical development of computer graphics to place today's system. Computer Graphics concept is also started with the invention of computer technology. History of the computer graphics we can include from the earliest text character images or from non-graphic mainframe computers to the latest photographic quality images and high resolution personal computers. The field of computer graphics dates back to the early 1960's with Ivan Sutherland, one of the pioneers of the field. This began with the development of the (by current standards) very simple software for performing the necessary mathematical transformations to produce simple line-drawings of 2- and 3-dimensional scenes. As time went on, and the capacity and speed of computer technology improved, successively greater degrees of realism were achievable. Today it is possible to produce images that are practically indistinguishable from photographic images.

The 1950s era:

Computing and calculating electronic devices were invented in 1945-50 A.D. In the 50s era the output devices were character based system so, there were used alphanumeric and symbolic based pictures. The images created or designed in this era were dark and light characters. Crude plotting of hardcopy devices such as teletypes and line printers were widely used in that era. The Whirlwind I Computer which is known as the first display unit developed in 1950 at the Massachusetts Institute of Technology (MIT) ,United States had computer-driven CRT displays for output. The (Semiautomatic Ground Environment) SAGE Air-Defence System developed in the middle 50s. It was the first command and control using CRT display that consoles on which operators identified targets with light pens(hand-held pointing devices that sense light emitted by objects on the screen).In this era Professor Coons designed the concept of "CAD" (Computer Aided Design) in 1958 and Coons surface in 1964.

The 1960s era:

In the 1060sbeginning there were modern interactive graphics output as the vector graphics techniques. The modern interactive graphics started with the inventions of a MIT student Ivan Sutherland's Sketchpad drawing system(software) in 1963 at the Lincoln Lab. So, He is known as a father of computer graphics. It was a Man-Machined Graphical Communication System. Sketchpad was the first program that is ever utilise a complete Graphical User Interface. It used a Lincoln TX-2 computer display unit (vector based monitor). And also developed interactive technologies that used the keyboard and light pen for making choices, painting adn drawing. In that 60s era released very simple computer generated film by Boeing's "Vibrations of an Aircraft". IBM released the IBM2250 graphics terminal that was the first commercially available graphics computer .In 1961 a MIT student Steve Russell created the first video game named" Spacewar". A scientist E. E. Zajac at Bell Telephone Laboratory (BTL), created a film called "Simulation of a two-giro gravity attitude control system" in 1963.

Also in 1966, Sutherland at MIT invented the first computer controlled head-mounted display (HMD). In 1968 Tektronix introduced the storage-tube CRT, which permanently retains a drawing until the user erase it. In 1968, another such devices were invented. The refresh display hardware for geometric transformations could scale, rotate and translate points and lines on the screen at real time. These systems could perform the 2D and 3D clipping and produce parallel and perspective projections. In the late 1960's, a French engineer Pierre Bezier creates Bezier curves and Bezier surfaces that are now used in most CAD and computer graphics systems.

The 1970s era:

In the 70's output system started using raster display system. The graphical display was still fairly chunks. In the era of 70s there was one of the most important advancement in computer graphics as the microprocessor (CPU). A number of animation houses were formed including Lucasfilm (George Lucas), creators of the Star Wars films. In 1975 Mandelbrot describes Fractal Geometry. Fractals are used in computer graphics to create realistic simulations of natural phenomena such as mountains, coastlines, wood grain, etc. The first major advance in 3D computer graphics was created at UU (Utah

University) by these early pioneers, the hidden-surface algorithm. With this algorithm the computer determines which surfaces are "behind" the object from the viewer's perspective, and thus should be hidden when the computer renders the image. In 1970, Bouknight proposed the first lighting reflection model which is also known as flat shading. In 1971,Gourand developed Gauraud Shading method that presents a method for creating the appearance of a curved surface by interpolating the color across polygons. In 1975, Phong proposed a local lighting model named as Phong lighting model which was one of the most important and influential lighting model. The development of inexpensive raster graphics, based on television technology in early seventies contributed more to the growth of the field. The Raster displays stores displays stores display primitives (lines, characters or areas) in a refresh buffer.

The 1980s era:

In the early 1980s, the availability of bit-slice and 16-bit microprocessors started to revolutionise high resolution computer graphics terminals which now increasingly became intelligent, semi-standalone and standalone workstations. The 1980s era outputs were built-in raster graphics, bitmap image and pixel. In this era Turner Whitted came up with the idea of Ray tracing. This was a new rendering method for simulating highly reflective surfaces. In January1984 Apple computer released which was the first personal computer with graphical user interface. The Macintosh remains a highly popular tool for computer graphics among graphic design studios and businesses. In this era personal computer cost decrease, trackball and mouse become the standard interactive device. Modern computers, dating from the 1980s often use Graphical User Interface (GUI) to present data and information with symbols, icons and pictures, rather than text. In 1984, the researchers of Cornell University and Hiroshima University introduced the concept and methods of radiosity in the field of heat radiation to computer graphics.

The 1990s era:

In the1990s era after the introduction of VGA (Video Graphics Array) and SVGA (Super Video Graphics Array), the personal computers can easily display photo-realistic images and movies. In this era became more popular in gaming, multimedia, and animation world. Since then, computer graphics have only become more detailed and realistic, due to more powerful graphics hardware and 3D modelling software. From 90s there started revolution in computer graphical films also. "Toy Story" was the first commercially successful full-length computer-generated animation film released in 1995.After than Terminator, Batman, Jurassic Park etc. movies were released. "Beauty and the Beast " movie released with many scenes contained 3D animated objects which were flat shaded with bright colours. In 2009 there released "Avtar" movie with full feature and very high color quality 3D scenes.

Early computer graphics started as a research and application field that was the domain of only a few experts, for instance in the area of computer aided design (CAD). Now a days, we can see various artificial activities in the graphical world. Cartoon films, animated films, with 3D high resolution. A ny person using a personal computer benefits from the developments in computer graphics. Operating systems and application programs with graphical user interfaces (GUIs) belong to the simplest applications of computer graphics. Visualisation techniques, ranging from simple histograms to dynamic 3D animations showing changes of winds or currents over time, use computer graphics in the same manner as popular computer games. Even those who do not use a personal computer might see the results of computer graphics on TV or in cinemas where parts of scenes or even a whole movie might be produced by computer graphics techniques. Computer graphics involved in the various fields like simulation, medical diagnosis, crime-enactment, cartoons and films etc.

5. HISTORY OF COMPUTER GRAPHICS IN ASPECT OF NEPAL:

Before researching about the history of Computer graphics in Nepal we must have knowledge of development of computer system in Nepal. The history of computer in Nepal is not that old since Nepal has not given any contribution in the development of evolution of computer. In 2018B.S. there was brought electronic calculator named Facit in Nepal for Census purpose. It was electronic calculation device. It was in 2028 B.S. when HMG brought IBM 1401 (a Second Generation computer) on rent for Rs. 1 lakhs and 25 thousand per month to process census data. This computer was GUI based system but not high graphical supporting device. Later the computer was bought by National Computer Center (NCC). In 2038 B.S., a fourth generation computer ICL 2950/10 was imported with the aid of UNDP and UNFPA from England for 20 lakhs US dollars. This computer had 64 terminals and it is kept in museum now. For this reason a separate branch called Yantrike Sanrinikarm Kndra(Electronic Data Processing center) was established in 1975 (2031 B.S.) which after six years was converted to National computer center (NCC).

At that time British Government helped to develop manpower of NCC. In the meantime Nepalese students went to India, Thailand and USA for the computer education themselves. In 2039 B.S., microcomputers such as Apple, Vector, Sins, etc were imported by private companies and individu als. Microcomputers such as Apple, Vector and Sirus were introduced in Kathmandu for the first time in B.S. 2039 (1983). Many private companies like Computer Consultancy (CC), management Information Processing System (MIPS), Data System International (DSI), etc were established. Such private companies started selling computers and training people in other to produce manpower in Nepal itself. Computer graphics system is also improved the advancement according to invention of advance devices. In 2063 Muni Bahadur Sakya assembled the First Super Computer in Nepal by combining sixteen microprocessors. Since 2062/63 the graphical system emerging fastly in Nepal. Various companies also established to developed various softwares and applications. In 2062 B.S. (2005 A.D.) Rodiant Infotech Nepal (P.) Ltd. (RINT) was established in Nepal to serve the country in the Computer Graphics field. In 2063 B.S. (2006A.D.) Webtech Nepal, Weblink Nepal, Broadway Infosis Nepal and more many companies established after then. Nowadays, several graphical designing systems are available in Nepal. In Film Industry, there is also involvement of computerized modeling and designing. The first Nepali film with the graphical effect is "Yeti ko Khoji Ma" of Laxman Basnet produced in Kathmandu by Visual Production Pvt. which is released in February 2067B.S. The first 3D movie"Vigilante" of Dependra Kumar Khanal produced by Aasma Films Production Pvt. in Chaitra 9,2070 B.S.

Nowadays, computers with faster processing and larger storage are found cheaply in Nepalese market. Students are given computer education from school level. At present Computer Association of Nepal (CAN) is the governing body of Nepal. Now-a-days probably each and every institutions, business organizations, communication centres, ticket counters etc. are using computers. Computer graphics educations are also getting by the students to design the GUI based softwares and other applications. Now a days, there are various educational centres are teaching about the computer graphics and animation topics as short term course also. Adobe Photoshop, Animated systems are widely using to modify the picture and to create animated objects. Nepalese film industry is also now a days improving their technologies and using advance high graphical systems to produce the high resolution movies and scenes.

6. APPLICATION OF COMPUTER GRAPHICS:

Computer graphics started with the display of data or hard copy plotter and CRT screens had grown include the creation, storage and manipulation of mode is of images of objects. These models come from a diverse set of fields and include physical mathematical, engineering, architectural, natural phenomena and so on. There is virtually no area in which graphical displays cannot be used. Today almost all application programs even for manipulating text or numerical data uses graphics extensively in user interface for visualizing and manipulating the application specific objects. Graphical interaction has replaced textual interaction with alphanumeric terminal. Even people who do not use computer encounter computer graphics in TV commercial or special effects. It is an integral part of all computer user interfaces and is independence for visualizing 2D, 3D and higher-dimensional objects. We find computer graphics used in a diverse areas as science, engineering, medicine business, industry, government, art, entertainment, education and others.

1. Computer Aided Design
2. Presentation
3. Computer Art
4. Education and training
5. Entertainment
6. Visualisation
7. Image processing
8. Graphical User Interface

1. COMPUTER AIDED DESIGN (CAD):

Computer Aided Design also referred as Computer Assisted Design. It is the system which consists the use of computer systems to assisting the creation, modification, analysis or optimization of design. It is sometimes known as computer-aided design and drafting (CADD). A CAD system is a combination of hardware and software. This system is used to increase the productivity of designer, improve the quality of design, and improve communications through documentation and to create a database for manufacturing. CAD has been a major driving force for research in computational geometry and computer graphics (both software and hardware).Architects, drafters, architectures, engineers and artists use CAD software to create plans and construction drawing. In Computer Aided Design, interactive graphics is used to design components and systems of mechanical, electrical, electromechanical and electronic devices including structures such as buildings, automobile bodies, aeroplane, textiles, space craft, watercraft, Very large scale integration chips, optical systems and telephone and computer networks.

With the advent of computer graphics, that the model could now be changed into a full 3-D rendering. With this advantage, automobile makers could animate their moving parts and test them. Architects are using interactive graphics methods to layout floor plans that shows positioning of rooms, doors, windows, stairs, shelves and other building features. The emphasis is on interacting with a computer-based model of the component or electrical or thermal properties.

2. PRESENTATION GRAPHICS:

Another major application area of computer graphics is the "Presentation Graphics". Presentation Graphics are used to provide illustrations for reports or to generate transparencies for use with graphics. Presentation Graphics is commonly used to summarize financial, statistical, mathematical, scientific and economic data for research reports, managerial reports and other types of reports. Typical examples are bar charts, line graphs, surface graphs, pie charts and other displays showing relationship between multiple variables. The 3D graphics are usually used simply for effects, they can provide a more diagrammatic or more attractive presentation of data relationship.

3. COMPUTER ART:

Computer graphics is used to generate arts. They are widely used in both fine art and commercial art applications. A fine art is drawn by artist hand and this kind of art is perfect to the artist skill. Artist use a variety of computer methods including special purpose hardware, artist paints brush program, other paint packages, specially developed software. Mathematics packages, CAD packages, desktop publishing software and animation packages providing facilities. Moreover, an artist uses a touchpad or a stylus or digitizer to draw pictures. The movement of object is captured by some input hardware. These arts are usually generated by using mathematical functions or algorithms. Computer art is not a realistic as fine arts. Mostly the commercial art is used to produce animations to demonstrate or present commercial products to the public. Find artists use a variety of computer techniques to produce images. These images are created using a combination of 3D modelling package, texture mapping, drawing programs and CAD software. These techniques for generating electronic images are also applied in commercial art for logos and other design, page layouts combining text and graphics, TV advertising sports, and other areas. Animations are also used frequently in advertising and TV commercial and produce frame by frame, where each frame of the motion is rendered and saved as an image file.

4. EDUCATION AND TRAINING:

Computer graphics is used in education and training field for making it more effective and more illustrative. To represent the teaching materials more interesting and attractive as diagrammatic and graphical form computer graphics can be used. For example: if a teacher is to teach bonding of molecules or electron jump from higher energy state to lower energy state or the structure of gene. Then he can demonstrate these concepts using computer graphics software or presentations. Another example could be taken for surgery. A student can learn surgery using data gloves and realistic computer graphics. This way the cost of education will be low and risk of human life as well. Other examples could be flight simulator and driving simulator for pilot and driving training. Modes of physical systems, physiological systems, population trends or equipments such as the color coded diagram helping trainees to understand the operation of the system.

5. ENTERTAINMENT:

Computer graphics methods are new that commonly used in making motion pictures, music videos and TV shows. Images are drawn in wire-frame form and will be shaded with rendering methods to produce solid surfaces. Graphics objects can be combined with the line action. Computer graphics are also used to introduce virtual characters to movies like character in various movies like Lord of the Rings, Igore, Sherk etc. Computer graphics is also widely used for gaming purpose. Various high definition games like God of War can be created using graphical software package.

6. VISUALIZATION:

Computer Graphics has major role in the scientific and business visualization fields. Generating computer graphics for scientific, engineering, and medical data sets is termed as scientific visualization and business visualization is related with the non-scientific data sets such as those obtained in economics. Visualization makes easier to understand the trends and patterns inherent in the huge amount of data sets. It would, otherwise, be almost impossible to analyse those data numerically.

7. IMAGE PROCESSING:

Image Processing is the process of analysing the pictures to derive descriptions (often in mathematical or geometrical forms) of objects appeared in the pictures. In Image processing there applies various techniques and tools to modify or interpret existing images or pictures such as photographs, TV scans

etc. Two major principles or applications related to the image processing are improving picture quality and machine perception of visual information. Image can be created using simple point program or can be fed into computer by scanning the image. These picture/ images need to be changed to improve the quality. Form image pattern recognition systems, images need to be changed in specified format so that the system can recognize the meaning of the picture. For example scanners with OCR features must have letters similar to standard font set.

SR	COMPUTER GRAPHICS	IMAGE PROCESSING
1.	In Computer graphics computer is used to create a picture or image.	In Image processing there applies various techniques and tools to modify or interpret existing images or pictures such as photographs, TV scans etc.
2.	Main principle is related to the new ideas and creativity of the designer.	Two major principles or applications related to the image processing are improving picture quality and machine perception of visual information.
3.	In graphical design there used various peripheral devices with the computer system and directly design the object.	To apply image processing methods, we first digitize pictures or photographs in to the image file then we can rearrange the image quality ,color and quality of shading.
4.	For examples: Computer Aided Drawings, Animated movies/pictures, 3D objects.	For example: X-Ray photographs, Satellite photographs etc.

8. GRAPHICAL USER INTERFACE:

GUI stands for Graphical user interface**.** Graphical user interface means a graphic, mouse-oriented paradigm which allows the user to interact with a computer. Computer Graphics methods now provides GUIs for software packages. A major component of GUI is window manager, which allows a user to display multiple-window areas. Each window can contain graphical or non-graphical displays. A typical GUI contains a window manager that holds icons, menus etc. for fast selection of processing options or parameter values.

Graphical User Interfaces have become key factors for the success of the software or operating system. GUI uses graphical objects called gizmos (a gadget) to represent certain objects or process involved in human computer communication for virtual purpose. Lots of aesthetics (colors) and psychological analysis have been done to create user friendly GUI. The most popular GUI is windows based GUI. Windows vista is the latest GUI based operating system. The GUI creators are putting having emphasis on 3D GUI creation.

UNIT: 2 OVERVIEW OF GRAPHICS SYSTEM

GRAPHICAL I/O DEVICES:

A computer is only useful when it is able to communicate with the external environment. Required devices to operate the computer whatever necessary devices or optional devices are also useful for the computer graphics. When you work with the computer you feed your data and instructions through some devices to the computer. These devices are called Input devices. Similarly computer after processing gives desired output through other devices called output devices. The input /output devices provide the capability of communication of computer system with its important devices/components which is in external environment. They are also known as Peripheral devices. Input devices are used to enter data and information from outside world to primary storage or main storage. And these devices perform the activity of inputting .Output devices supply the results of processed operation from primary storage to the user. Both Input and Output devices used for perform input and output function in the system.

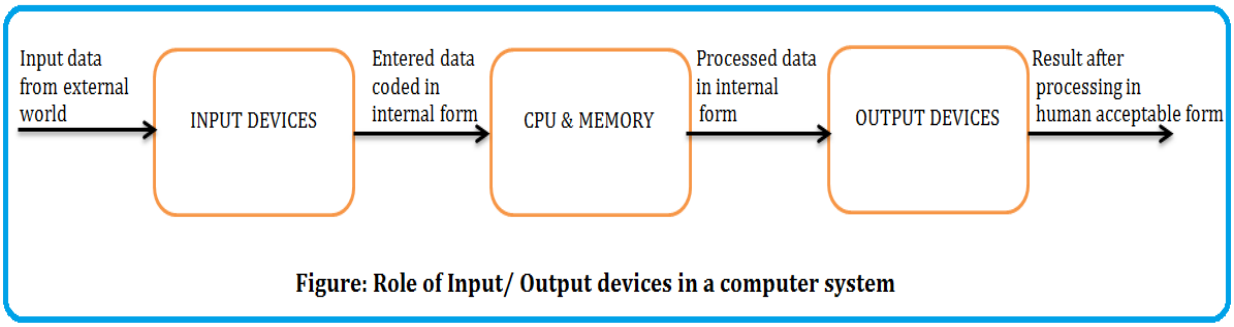


Figure: Role of Input/ Output devices in a computer system

Role of Graphical Input/output devices:

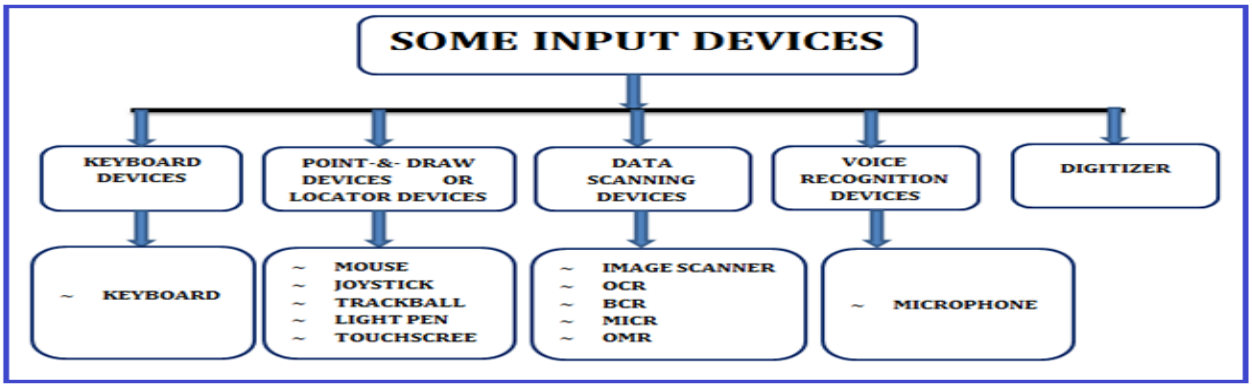
1. Input /Output devices provide the capability of communication of computer system with its important devices, components which is in external environment.
2. Input /output devices are peripheral devices and external devices of computer system and important part for the computer graphics.
3. Some of these devices are play the role of major components for the computer graphics and some of these devices are used as the requirements of the user to create, modify and improve the graphical object.
4. Data and instruction can be entered in to computer through input devices in the form of typing (text), voice and picture.
5. Receives processed information from computer and provides them to the user in graphical display form (soft copy output) or printed form (Hard copy output).

2. GRAPHICAL INPUT DEVICES:

Various Hardware devices as input devices, scanning devices, pointing devices and outputting devices are used for the computer graphics. These all devices are also named as interactive graphics devices. Input device are used to feed data or information into a computer system. They are usually used to provide input to the computer upon which reaction, outputs are generated. Graphics input can be in a form of voice, text or image. To enter any type of data there used the required graphics device. Data input devices like keyboards are used to provide additional data to the computers in the form of text whereas pointing and selection devices like mouse, light pens, touch panels are used to provide visual and indication-input to the application. Various scanners like Optical Character Reader (OCR), Bar code Reader (BCR) types of devices are used to enter data into the computer in the form of image or picture.. These devices read the raw data prepared by the user and send them in to the computer as a series of electronic pulse. The input device established the communication link between user and the computer system. Input devices are necessary to convert our information or data in to a form which can be understood by the computer. A good input device should provide timely, accurate and useful data to the main memory of the computer for processing followings are the most useful input devices.

Category of commonly used graphical input devices:

1. Keyboard devices :Keyboard
2. Pointing and drawing or Locator devices: Mouse, Trackball, Space ball, Joystick, Light Pen, Touch Screen
3. Data Scanning devices :Image Scanner, OCR, OMR, BCR, MICR
4. Electronic card based devices : Card reader, ATM
5. Digitizer
6. Voice/Speech Recognition devices : Microphone



Some of the Graphical Input Devices:

1. Data Glove:

Data gloves are based on the concept of virtual reality. Data gloves can be used to grasp a "virtual" object. It is constructed with a series of sensors that detect hand and finger motions. Electromagnetic coupling between transmitting antennas and receiving antennas is used to provide information about the position and orientation of the hand. The transmitting and receiving antennas can each be structured as a set of three mutually perpendicular coils, forming a three-dimensional Cartesian coordinates system. Data gloves are one of the several types of electromechanical device used in haptics application i.e. the science of applying tactile sensation to human interaction with computer.

2. Touch-Panel:

Touch panels are a sensitive surface that is used to point directly. The panel can be touched by finger or any other object like stylus transparent touch panels are integrated with computer monitor for the manipulation of information display. Touch panels allows the users to point at screen directly with a finger to move the cursor around the screen, or to select icons. A basic touch panel senses voltage drop when a user touches the panel. It knows where the voltage has dropped and accordingly calculates the touch position. Following are the mostly used touch panels:

- Optical touch panels
- Sonic panels or acoustical touch panels
- Electrical touch panel

An optical touch panel uses Infrared (IR) emitters and sensor on X and Y-axis sides, emitter are placed and on the opposite sides sensors are placed when a user touches the screen, the point will interrupt two IR beam from X and Y-axis. This is detected by IR sensors and the touch position is calculated.
In Acoustic (Sound) based touch panel uses very high frequency (5 Mhz). The sound waves are generated from X-axis and Y-axis sides are reflected from opposite side of either axis. When user touches the panel, the sound waves are interrupted and reflected back from their mid wave. The sensors on the X-axis and Y-axis sides measured the time, the sound waves took to get reflected back and estimate the touch position.

Resistant based touch panel uses two substances of glass or plastic separates by insulators. When a user touches the panel these two substances are connected and the resistance at that point will drop down. The resistance drop is sensed and the touch position is calculated.
In capacitance based touch panel, some charge is spread on the screen. When user touches the panel the charge is drawn by finger form each side proportionally. The sensor calculates the charge in frequency of charge/voltage and find out the touch position.

Advantages:

- Touch panel can be mounted on display screen leaving more space on desktop but mouse, joystick etc. take some space.
- Provides easier environment to operate.

3. Tablets:

Generically, a **tablet PC** refers to a laptop or slate-shaped mobile computer, equipped with a touchscreen or graphics tablet/screen hybrid to operate the computer with a stylus or digital pen, or a fingertip, instead of a keyboard or mouse. A common device for drawing, painting or interactively selecting co-ordinate position on an object is a digitizer. Typically a digitizer is used to scan over a drawing on object and to input a set of discrete coordinate position which can be joined with straight line segments to approximate the curve surface shape. One type of digitizer is Graphics tablets (data

tablets), which is used to input two dimensional (2D) co-ordinate by activity a hand curser or stylus as selected position, flat surface. A hand curser contains cross hairs for sighting position, while a stylus is a pencil shaped device that is pointed to the position of the tablet. Many graphics tablets are constructed with a rectangular grid of wires embedded on the tablet surface. This form factor offers a more mobile way to interact with a computer. Tablet PCs are often used where normal notebooks are impractical or unwieldy, or do not provide the needed functionality. Electromagnetic pulses are generated in sequence along the wires and an electric signal is induced in a wire coil. In an activated stylus or hand curser to record tablet position. Acoustic (Sonic) tablets use sound waves to detect a stylus position. Either strip microphones or point microphones are used to detect the sound emitted by an electrical spark from a stylus tip. The position of the stylus is calculated by calculating the arrival time of generated sound at different microphone position.

Specifically, **Tablet PC** refers to a product announced in 2001 by Microsoft, and defined by Microsoft to be a pen-enabled computer conforming to hardware specifications devised by Microsoft and running a licensed copy of the "Windows XP Tablet PC Edition" operating system or a derivative therefore.

Advantages of Tablets:

- It is a digitizer
- Scan over an object and create discrete co-ordinate positions
- These points can join in a tiny straight line segments to appropriate shape of the original object.
- Can be moving stylus(pencil-shaped device) or puck(like mouse with cross hairs for sighting position) heldin user's hand-size varies from 6x6 inches up to 48x72 inches or more.
- Accuracy below 0.2 mm.

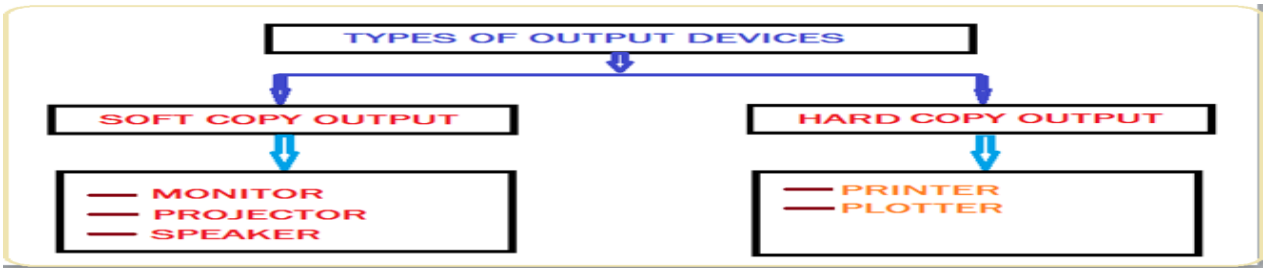
4. Digitizer:

Digitizer is an input device used for converting picture, maps, and drawings into digital form for storage in computers. It is a common input device for drawing, painting, or interactively selecting coordinate positions on an object. A digitizer consists of a digitizing tablet also called graphic tablet associated with a stylus. A digitizing tablet is a flat surface that contains hundreds of fine copper wires forming a grid. It is used to scan over a drawing or object and to input a set of discrete coordinate positions that can be joined with straight –line segment to approximate the curve or surface shapes. One type of Digitizer is the graphics tablet or data tablet which is used to input two dimensional or a three dimensional space.

3. GRAPHICAL OUTPUT DEVICES:

Output is the action of getting information from the computer. It is processed information and result that produced through several output devices. Once the CPU has executed the program instruction, may ask that information be communicated to on output device. Output devices are those hardware which accept processed result from the primary memory and supply it to the users or store it to secondary device for future use. The output devices translate the data process in the computer from machine code to human code. Some output devices produce the output on the screen or voice system and some output devices produces output as the printed material. The output devices have two forms:

- Softcopy output devices (VDU)
- Hardcopy output devices



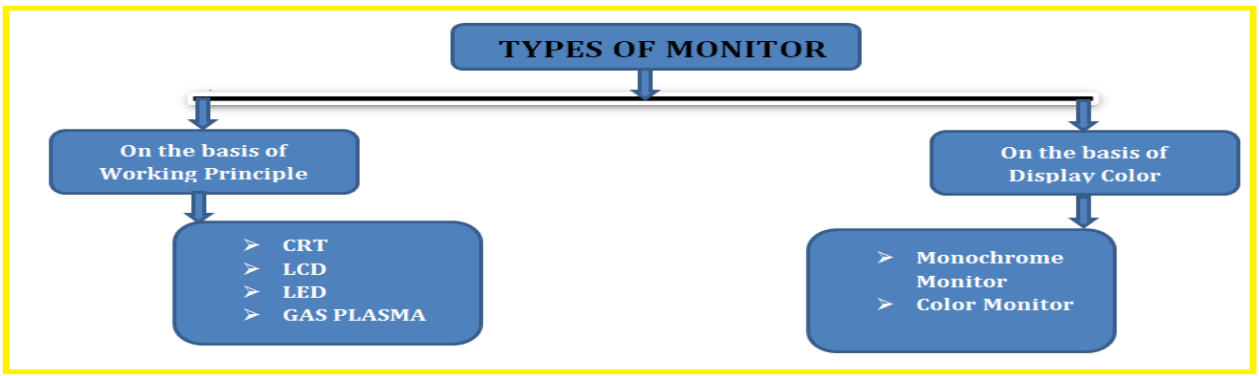
Softcopy output devices (VDU): A softcopy output is an output, which is not printed on paper or on some material. Softcopy output cannot be touched and cannot be carried for being shown to others. It is temporary in nature and vanishes after use. The information displayed on the monitor disappears as soon as you turn off the monitor. The output displayed on a terminal/ monitor screen or spoken out by a voice response system is an example of soft copy output. Softcopy devices enable viewing of work, which allows correction and rearrangement of materials to suit specific needs. Monitor, Projector, and Speakers are the examples of softcopy output devices. The softcopy devices do not contain expenditure on stationary and the output can be seen faster. The pproperties of video display devices are persistence, resolution, and aspect ratio.

Hardcopy output devices: A Hardcopy output is an output, which is printed on paper or on some other materials. It can be touched and carried for being shown to others. They are permanent in nature and can be kept in paper files or can be looked at a later time when the person is not using the computer. They can be kept safely for the future use. Printers, Plotters are the examples of hardcopy output devices. The hardcopy output cannot be changed and modified later. The output produced by the hardcopy output devices can be reused for the longer time.

SN.	SOFTCOPY OUTPUT DEVICES	HARDCOPY OUTPUT DEVICES
1.	Produced result through softcopy output devices is temporary in nature.	Produced result through hardcopy output devices is Permanent in nature.
2.	Softcopy output devices produce result on the monitor screen or spoken out by the speaker.	Hard copy output devices produce result as printed material.
3.	The output produced through softcopy output devices is not printed on the paper.	The output produced through hardcopy output devices is printed on the paper.
4.	The output produced through softcopy output devices can be changed and modified easily.	The output produced through hardcopy output devices cannot be changed and modified.
5.	Softcopy output material can also be saved into electronic medium like hard disk, pen drive etc. for future use.	Hardcopy output material cannot be saved into electronic medium.
6.	Softcopy output can be produced through devices are faster than hardcopy output.	Hard copy output can be produced through devices are slower than softcopy output.
7.	Monitor, Speaker, Multimedia Projector etc. are examples of Softcopy output device.	Printer, Plotter etc. are examples of Hardcopy output devices.

1. Monitor (Visual Display Unit):

The most popular output device is the Visual Display Unit (VDU). It is sometimes referred as Visual display terminal (VDT). It is also called the monitor. Monitor is the display screen used to display the text and graphics, allowing users to view the result after processing of data entered through input devices. Monitor is used to display the input data and to receive messages from the computer. It is the most common and popularly used output device for producing softcopy output. It displays the generated output on a television like screen. A monitor has its own box which is separated from the main computer system and is connected to the computer by cable. In some systems it is compact with the system unit.



i) Monochrome Monitor: Monochrome word is made by mono + chrome where "mono" indicates one and "chrome" indicates color. So, Monochrome monitors show their images in one color but these perform displaying function as background color and foreground color (Two colors). Sometimes it referred as Black and white monitor. These monitors are used for text-like displays. The display color of the monochrome monitor can be black and white, green and black, amber (yellowish-brown) and black.

ii) Color Monitor: The color monitors display anywhere from 16 to 1 million different colors. Color monitors sometimes called RGB because they accept three separate colors red, green and blue. An RGB monitor consists of a vacuum tube with three electron guns-one each for red, green and blue colors. Color monitors are sometimes classified by the number of bits they use to represent each pixel. The electron guns fire electrons at the phosphorous coated screen. When the electron beams excite the phosphors dots they glow. Color monitors are often classified by the number of bits they use to represent each pixel. The more bits per pixel; means the more colors the monitor can display. For example a 24-bit monitor represents each pixel with 24-bits.

DISPLAY TECHNOLOGIES:

1. *REFRESH CATHODE-RAY TUBE:*

The most popular output device is the Visual Display Unit (VDU). It is sometimes referred as Visual display terminal (VDT). It is also called the monitor. Monitor is the display screen used to display the text and graphics, allowing users to view the result after processing of data entered through input devices. It is the most common and popularly used output device for producing softcopy output. Different types of monitors have different technologies used in them but the operation of commonly used monitors is based on Cathode Ray Tube (CRT)The first CRT developed by Ferdinand Braun in 1897 in Germany.

The monochromatic CRT's used for graphic displays are essentially the same as those used in black-and-white home television sets. Every monitor has an electronic gun which creates or emits a beam of electrons (electrons means cathode rays or some signals). A electron beam, emitted by an electron gun which passes through focusing and deflection systems. The beam of electron strikes at specified points on the phosphor coated screen. The phosphor then emits a small spot of light at each position contacted by the electron beam. The light of phosphor fades after sometime. So electrons beam is repeated quickly to redraw picture in the screen on same point. The phosphor in screen is of difference persistence. The turn persistence is used to represent time internal during which phosphor emit after beam is removed. The phosphor may have low or high persistence. If persistence is low then it will be suitable for animation. If persistence is high it will be used for display highly complex pictures in CRT. We use cathode to heat the electrons. Cathode is heated by filament. The electrons are accelerated toward phosphor coating by high positive voltage. One way to keep the phosphor glowing is to redraw the picture repeatedly by quickly directing the electron beam back over the same point. This type of display is called a refresh CRT.

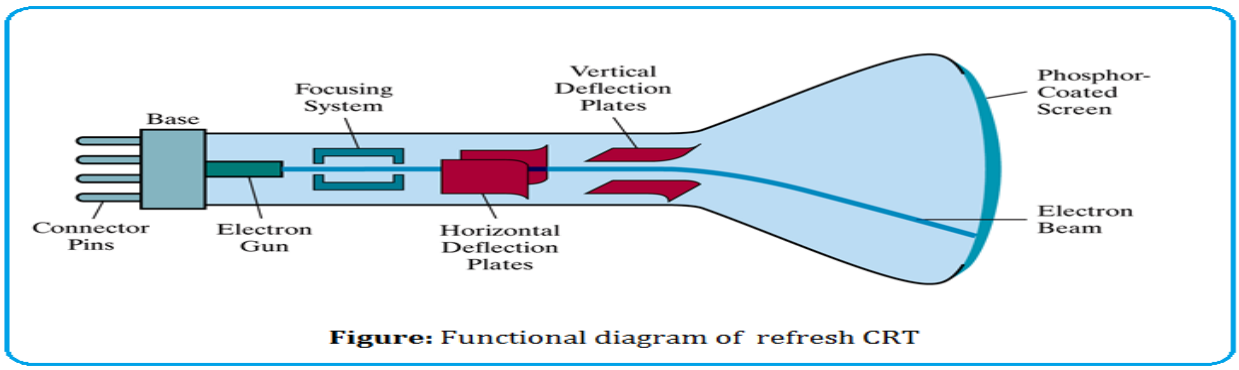


Figure: Functional diagram of refresh CRT

It consists of the following main parts: CRT, Electron gun, Focusing system, Deflection system, phosphor coated screen. Description of the above parts given below:

Electron Gun: At the back of the monitor is a set of electron guns which produce a controlled stream of electrons. To produce a picture on the screen, these guns start at the top of the screen and scan very rapidly from left to right. Then they return to the left-most position one line down and scan again, and repeat this to cover the entire screen. The primary components of an electron gun in a CRT are the heating filament, cathode and control grid.The heat is applied to the cathode by directing a current through a coil of wire In the CRT, is called filament. When current is passed through a coil of wire (filament), the cathode gets heated. This causes electrons to be emitted from the hot cathode surface. The negatively charged electrons are accelerated toward the phosphor coating by a high positive voltage.

Control Grid: It is a metal cylinder which is used to surround the cathode. Grid is cylindrical in shape. Grid has hole at one end, through which electrons get escaped. The control grid is kept at lower potential as compared to cathode, so that a electrostatic field can be created. It will direct that electrons through point source, so process of focusing will be simplified. A high negative voltage applied to the control grid will shut off the beam by repelling electros and stopping them from passing through the small hole at the end of the control grid. The brightness of picture can be controlled by adjusting follow of electrons and current in beam.

Focusing System: It is needed to force the electron beam to converge into a small spot as it strikes the phosphor. Focusing is accomplished with either electronic or magnetic fields. With electronic focusing, the electron beam passes through a positively charged metal cylinder that forms on electrostatic lens. Electrostatic focusing is commonly used in television and computer graphics monitors. The magnetic focusing system is achieved by setting up a coil mounted around the outside of the CRT envelope. Additional focusing hardware is used in high-precision systems to keep the beam in focus at all screen positions.

Deflection System: It is also called as yoke. Deflection system directs the electron beam at a particular point on the screen. The deflection plates are used to control the deflection of the electron beam. Two pairs of deflection plates are used with each pair mounted on the opposite side of the neck of the CRT. Deflection of the electron beam can be controlled either with electric fields or magnetic fields through the deflection plates. Cathode-ray tubes are commonly constructed with magnetic deflection coils mounted on the outside of the CRT envelope. Deflection system consists of two pairs of coils. One coil control horizontal deflection, whereas other control vertical deflection. The deflection coils deflect the information rapidly so that it can be displayed clearly on the screen. The proper deflection amounts are attained by adjusting the current through the coils.

Phosphor: It is a substance that can emit light when irradiated with particles of electromagnetic radiation. It is also known as a special organic compound. A variety of phosphor available at the end of the CRT. Phosphor has different colours. Colour generally used is white. White colour is suitable for dark background. It should have high efficiency in term of electric energy converted into light. When the phosphors emit light that is called phosphorescence.

In raster scan display, the electron beam return to the left of the screen after refreshing each scan line, is called horizontal retrace of the electron beam. In raster scan display, at the end of one frame, the electron beam returns to the left top corner of the screen to start the next frame, is called vertical retrace of the electron beam. Properties of phosphor are:

- Color
- Persistence

2. COLOR CRT:

Colour monitors are sometimes called RGB monitors. A colour CRT monitor consists of a vacuum tube with three electron guns-each for red, green and blue at one end and the screen at the other end. The electron guns are arranged either in a straight line or in a triangular configuration but the guns are usually constructed as a single unit. These three electron guns fire electrons at the screen, which contains a phosphorous coating. When electron beam excite the phosphorus, they glow. The colour of the screen depends on the electron which one excites the phosphorus then they glow red, green or blue. The three beams should converge for each point on the screen so that each pixel is a combination of the three colours.

The CRT monitor displays colour picture or image by using a combination of phosphorous that emits different coloured light. By combining the emitted light from the different phosphorous, a range of colours can be generated. Two basic techniques for producing colour display with CRT are:

1. Beam penetration method:
2. Shadow-mask Method. (Roster)

Beam penetration method:

This technique is used in random-scan display systems. Two layers of phosphor (red and green) are coated on to the inside of the CRT screen, the displayed colours depends on how far the electron beam penetrates into the phosphor layers. A slow electron beam excites only the outer red layer. A high speed electron beam excites the inner green layer and averaged speed electron beam at the intermediate speed that produces combination of red and green colour (lights) as two additional colours yellow and orange. The speed of the electron is controlled by the beam acceleration voltage. It is an in expansive technique but only four colours are possible. The quality of picture is not good than other method.

The merits and demerits of the Penetration techniques are as follows:

- It is an inexpensive technique
- It has only four colors
- The quality of the picture is not good when it is compared to other techniques
- It can display color scans in monitors
- Poor limitation etc.

Shadow-mask Method

This technique is used in raster-scan display systems. The technique produces a much wider range of colours than beam penetration method. The three types of phosphorus dots is coated in each pixel that is red, green and blue. Just behind the CRT screen shadow mask grid (metal grid) is placed whose number is same as a number of pixel. Three electron guns are adjusted for each phosphorous. One phosphor dot emits red light, another emits a green light and the third emits blue light. This type of CRT

has three electron guns, one for each colour dots. The electron beams are detected and focus on the shadow mask hole. The Passed from the hole activate the dot triangle and produce the colour spot on the screen. The colour of pixel is controlled by light of intensity. By combing three colour,17 million colour can be obtained. For true colour each pixel has 24bits in the frame buffer. The colour we see on the screen depends on the amount of excitations of the red, green and blue phosphor.

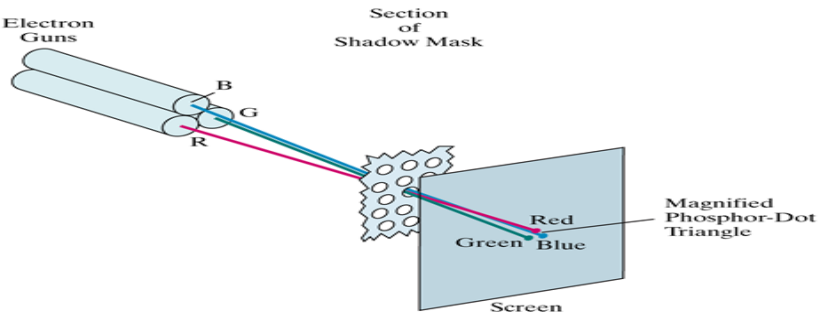


Figure: Color CRT electron gun and shadow mask arrangement. An electron gun for each color- Red, Green and Blue.

Advantages of CRT monitor:

- It has wider viewing angle.
- It is cheaper and durable.
- It gives sharp and crisp image.
- It has adjustable resolution.

Disadvantages of CRT monitor:

- It is bulky and heavy.
- It consumes high electricity power.
- The screen may flicker causing eyestrain.
- Takes more space to place it.

3. FLAT- PANEL DISPLAY:

Although most graphics monitors are still constructed with CRTs, other technologies are emerging that may soon replace CRT monitors. The term Flat-panel display refers to a class of video devices that have reduced volume, weight, and power requirements compared to a CRT. A significant feature of flat-panel displays is that they are thinner than CRTs, and we can hang them on walls or wear them on our wrists also. Since we can even write on some flat-panel displays, they will soon be available as pocket notepads. Current uses for flat-panel displays include small TV monitors, calculators, pocket video games, laptop computers, armrest viewing of movies on airlines, as advertisement boards in elevators, and as graphics displays in applications requiring rugged, portable monitors. At present, flat-panel displays are commonly used in small systems and in special-purpose systems.

We can separate flat-panel displays into two categories: **Emissive displays** and **Non-emissive displays**. The emissive displays (or emitters) are devices that convert electrical energy into light energy. Plasma panels, thin-film electroluminescent displays, and Light-emitting diodes are examples of emissive displays. Flat CRTs have also been devised, in which electron beams arts accelerated parallel to the screen, then deflected 90' to the screen. But flat CRTs have not proved to be as successful as other emissive devices. Non-emissive displays (or non-emitters) use optical effects to convert sunlight or light from any other source into graphics pattern. The most important example of a non-emissive flat-panel display is a liquid-crystal device.

Liquid Crystal Display (LCD) Monitor:

LCD monitor is the type of Flat Panel display like Electroluminescent (EL) and Plasma Display. LCD is the most common flat panel monitor. It creates images with a special kind of liquid that is normally transparent but becomes opaque when charged with electricity. The liquid crystalline material is sandwiched between two glass or plastic plates. The front plate is transparent and the back is reflective. LCD is lighter in weight, not bulky but expensive compared to CRT monitors. It consumes low voltage and power consumption. The user should sit in front to monitor, if she /he sits with angle, contents are not visible. It does not emit light as CRT, so there is no enough contrast between the image and the background. It is widely used in laptops, computers, digital cameras, digital clocks, digital watches, microwave ovens, CD players etc.

Note: Liquid crystal is a combination of two states of matter – the solid and the liquid. They have both the properties of solids and liquids and maintain their respective states with respect to another.

Liquid crystals are more heat sensitive than usual liquids. A little amount of heat can easily turn the liquid crystal into a liquid. This is the reason why they are also used to make thermometers.

Advantages of LCD Monitor:

- Flat Screen
- Lightweight
- Less electricity power consumption.
- Avoids eye strain problem.
- Takes less space.

Disadvantages of LCD Monitor:

- Consists smaller viewing angle.
- Images are less sharp.
- Resolution is normally set.

Light Emitting Diode (LED) Monitor:

Light Emitting Diode is also an advance technology consisting monitor. This is the type of Emissive Flat-Panel display. LED is a semiconductor light source system and this system at first introduced as a practical electronic component in 1962. This is used the Emissive Technology in which electrical energy is converted into light. This technology is most commonly found in calculators, retail checkout counters, large digital watches and automatic teller devices. These are the devices which converts the electrical signals into light. LED displays use backlights designed with an array of lights. The lights are evenly arranged on the back of the panel or positioned on the screen edges. LED monitors are expensive at approximately 20% more than LCD monitor.It contains a matrix of diodes those are arranged on the screen as the pixel position. And the picture definition is stored in the Refresh buffer and when information is read from the refresh buffer and then it is converted into the voltage levels and it is applied to diodes which produce the light pattern in the display.

Advantages of LED monitors:

- It has long life.
- Avoids eye strain problem.
- Flat Screen
- Lightweight
- Less electricity power consumption.
- It has wider viewing angle.

Gas Plasma Display:

Gas Plasma Display is a type of Flat display screen. It is also named as a Flat –panel display. It is used in some portable computers and widely used for large TV displays (typically above 37-inch).The major components of plasma displays are: Fresnel lens, Optional deflection coils, Electrostatic deflectors, Optional deflectors and cathode. It produces very sharp monochrome images.Gas Plasma display is like a neon bulb, in which the display uses a gas that emits light in the presence of an electric current. That is, the technology uses predominantly neon gas and electrodes above and below the gas. When, electric current passes between the electrodes, the gas glows. It works by sandwiching neon or xenon gas between two plates. Each plate is coated with a conductive print. The print on one plate contains vertical conductive lines and the other plate has horizontal lines. When electronic current is passed through a horizontal and vertical line, the gas at the intersection glows, creating a point of light , or pixel.

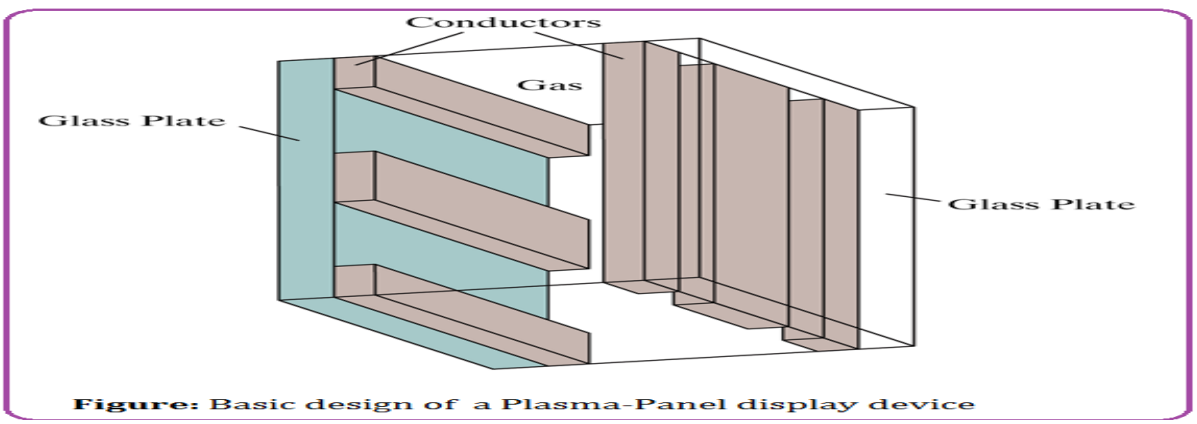


Figure: Basic design of a Plasma-Panel display device

Advantages of Gas-Plasma Display:

- An image produced is colorful and bright.
- The scenes/images look natural.
- Larger viewing angle.
- Avoids eye strain and tired problem.
- Refreshing is not required.
- Less bulky than a CRT.

Disadvantages of Gas-Plasma Display:

- Expensive
- High power consumption.
- Takes more place.
- Poor resolution of up to 60 dpi.

Differentiate plasma panel display and thin film electro luminescent as followed: In plasma panel display, the region between two glass plates is filled with neon gas. In thin film electro luminescent display, the region between two glasses plates are filled with phosphor, such as zinc supplied doped with manganese.

4. GRAPHICS DISPLAY SYSTEM

I. RASTER-SCAN DISPLAY SYSTEM

The raster graphics developed in early 70's. The term "Raster-scan" is used for raster graphic which is the pattern of image storage and transmission that used in most computer bitmap image systems. Raster Scan display system is based on the Television technology. The most common type of graphics monitor employ in a CRTs is the Raster-Scan display system. In this system, electron beam swaps across the screen one row at a time from top to bottom. As the electron beam moves across each row, the beam intensity is turned on and off to create a pattern of illuminated spots. Picture definitions are stored in refresh buffer or frame buffer which holds the setup intensity values for the entire screen point i.e. pixel. Stored intensity values are then retrieved from the refresh buffer and painted on the screen one row (scan line) at a time.

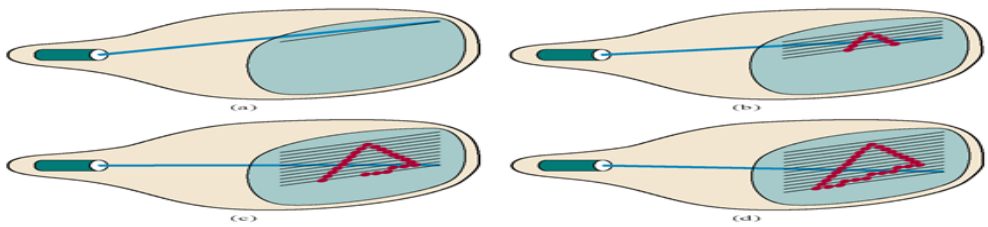


Figure: A Raster-scan system displays an object as a set of discrete points across each scan line.

The capability of a raster-scan system to store intensity information for each screen point makes it well suited for the realistic display of scenes containing subtle shading and colour patterns. In monochrome monitor (black-and-white system) frame buffer consists of one bit per each pixel and for colour monitor frame buffer consists of 24 bits for each pixel. The refresh rate for this system is at the rate of 60 to 80 frame per second. i.e. refresh rate are described in units of cycle per second. It is well suited for realistic scenes containing shading and colour pattern. Home television sets and printers are examples of other systems using raster-scan methods.

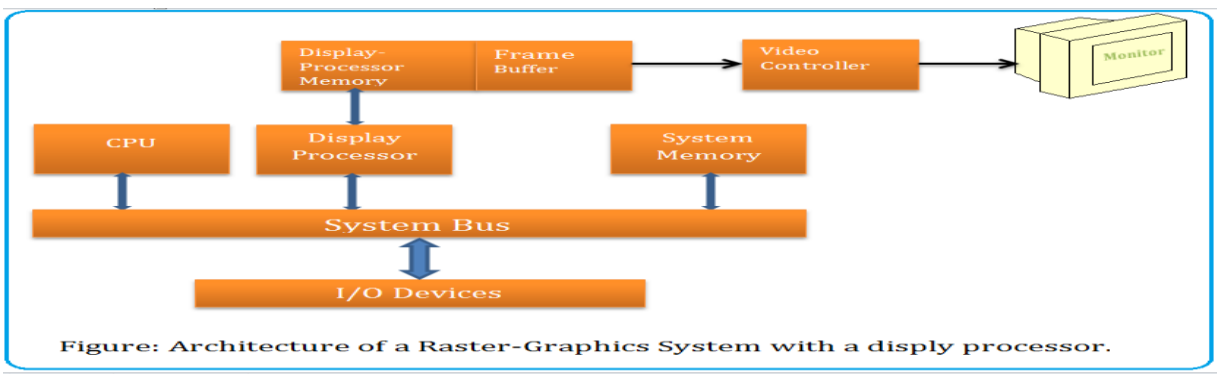


Figure: Architecture of a Raster-Graphics System with a disply processor.

Interactive Raster Graphics systems typically employ several processing units. In addition to the CPU, a special purpose processor (Video controller / display controller) is used to control the operation of the display device. In addition to the Video controller other processor and accelerator can be employed to implement various graphics operations.

Function of main components of Raster-Scan display system:

System Memory:
The system memory holds data and those programs which execute on CPU: the application programs, graphics package and operating system.

Display Processor Memory:
It holds data and the programs which perform scan conversion and raster operations.

Frame Buffer:
Picture definition is stored in a memory is called Frame buffer. It is sometimes also referred as refresh buffer. This memory area holds the set of intensity values for all the screen points. Stored intensity values are then retrieved from the frame buffer painted on the screen point (pixel) one row at a time.

Video Controller:
Video controller is also called Video Adapter. The electronic components required to generate a video signal that is sent to the video display through a cable. The video controller is usually located either on the computer's main system board or on an expansion board, but it can also be part of a terminal. Video controller is used to control the operation of the display device. A fixed area of the system is reserved for the frame buffer, and the video controller is given direct access to the frame buffer memory. Frame buffer can be anywhere in the system memory and the video controller accesses the frame buffer to refresh the screen. Video controller also contains a look up table instead of controlling CRT beam intensity directly. This provides a fast mechanism for changing screen intensity values. To perform the basic refresh operation of the video controller two registers are used to store the coordinates of the screen pixels. Initially the X-register is set to 0 (zero) and Y register is set to Y-max (i.e. X=0 and $Y=y_{max}$). In some personal computers, the coordinate origin is referenced at the upper left corner of the screen. It provides direct access to the frame–buffer memory. Frame buffer may a fixed area of the system memory or may be special memory of display processor which is used to store the picture definition. Video controller can be performed other operations like to mix the frame-buffer image with an input image from a camera or other devices.

Where the video controller is used?
A special purpose processor, which is used to control the operation of the display device, is known as video controller or display controller. A fixed area of the system is reserved for the frame buffer, and the video controller is given direct access to the frame buffer memory.

Display Processor:
Display Processor is referred as graphics controller or display coprocessor. The purpose of the display processor is to free the CPU from the graphics chores. In addition to the system memory, a separate display processor memory area can also be provided. The main task of the display processor is to digitize a picture definition (called scan converting) given to an applications program into a set of Pixel – intensity values for storing them in the refresh buffer. A display processor performs the additional functions like generating various line styles (dotted, dashed or solid), displaying color areas, performing certain transformations and manipulation of displayed object.

Lines and other geometric objects are converted into set of discrete intensity points. Characters can be defined with rectangular grids, or they can be defined with curved outlines. To reduce the memory space required to store the image information, each scan line are stored as a set of integer pairs. One number of each pair indicates an intensity value, and the second number specifies number of adjacent pixels the scan line that is also having same intensity. This technique is called run-length encoding. Sophisticated display processor can perform complex operations like: storing list of display instructions by using local memory, clipping and window-to-viewport transformations, 3D geometric transformations and clipping, local segment storage or display list storage etc.

The display processor read the data from the frame buffer and convert it into corresponding 1's and 0's according to their pixels and then put it on to a monitor screen. The display processor do this work 30 times per second to maintain a steady picture on the screen and if we want to change the picture on the screen then we have to change the contents of frame buffer. Display processors are also designed to perform a number of additional operations these operations include:

· Generating various line styles (dashed, dotted or solid)

· Display color areas

· Performing certain transformations

· Manipulations on displayed objects.

Advantages of Raster-scan system:

- Raster-Scan systems are designed for display realistic shaded scenes.
- Raster-Scan systems consist advanced devices like video control, coprocessors etc.
- Raster scan is easier and less expensive to implement than in random scan system.
- One major advantages of raster graphics over vector graphics includes the ability to display areas filled with solid colors or patterns.

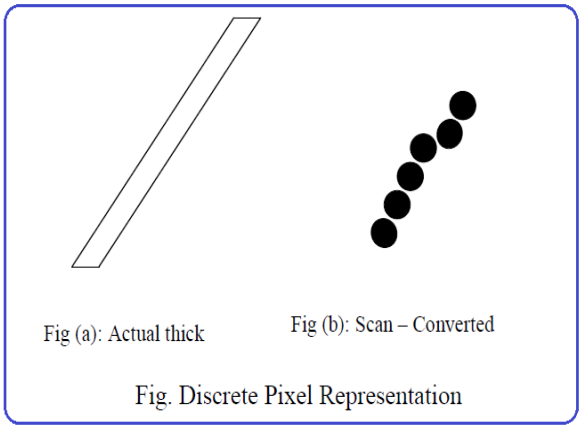
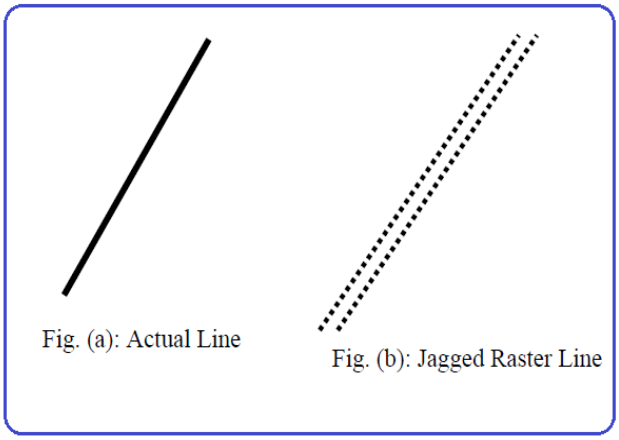


Fig. Discrete Pixel Representation



Disadvantages of Raster-scan system:

- Major disadvantage of raster system compared to vector system is the discrete nature of the pixel representation. This happens due to scan-conversion of end points (vertices) into their component pixels in frame buffer.

II. RANDOM-SCAN DISPLAY SYSTEM

A random scan display system is also called vector, stroke writing or calligraphic system where electron beam is directed only to the part of the screen where the picture is to be drawn. In a random scan display, an image on the screen is drawn with one line at time. An application program is input and stored in the system memory along with the graphic package. Graphics commands in the application program are translated by the graphic package in to a display file (sometimes referred as display list or display program or refresh buffer) stored in the system memory. This display file is then accessed by the display processor to refresh the screen. Sometimes the display processor in a random scan is referred to as a display processing unit or a graphics controller. The buffer stores the computer produce display list or display program which contains points and line plotting commands with (x , y) and end point co-ordinates as well as character plotting commands. The commands for plotting point's lines and characters are interpreted by the display processor.

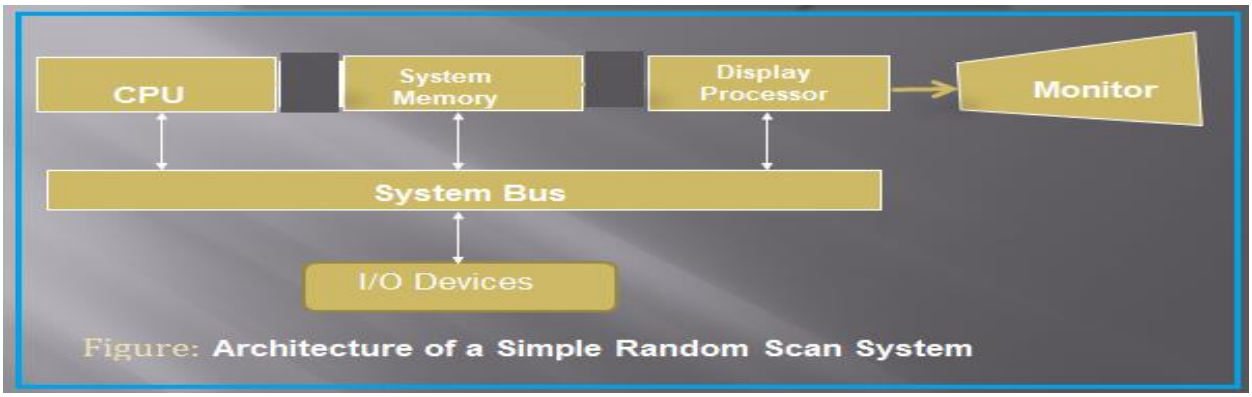


Figure: Architecture of a Simple Random Scan System

The main principal of the random scan system is that the beam is deflected form end point to end point as detected by arbitrary order of the display commands term as random scan. Random scan display system is mostly used for line drawing applications and can not display realistic shaded scenes.

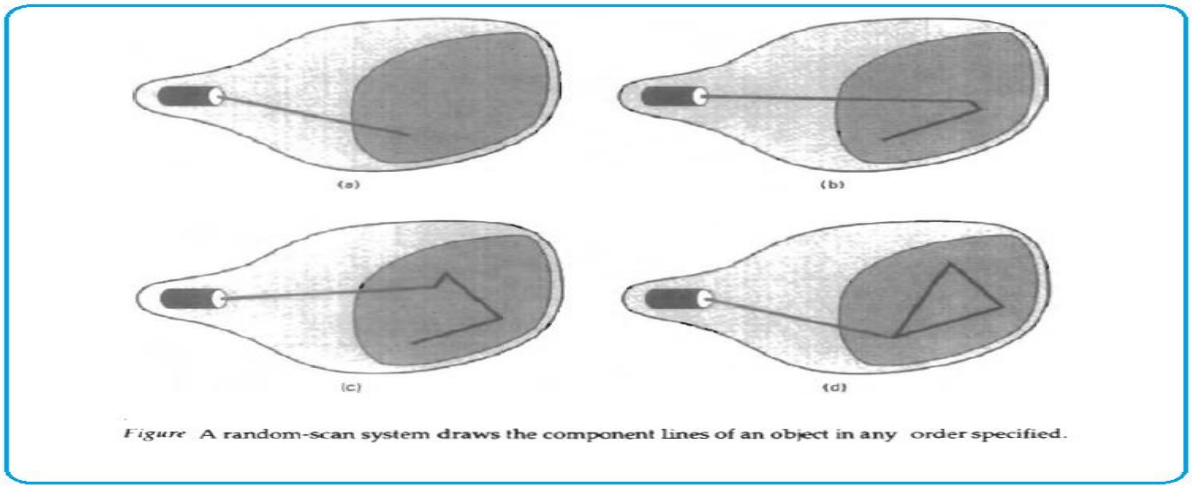


Figure A random-scan system draws the component lines of an object in any order specified.

It has higher resolution It produces smooth line drawing because the CRT beam directly follows the line path definitions that are stored in the form of line drawing commands. Refresh rate on a random scan system depends on the number of lines to be displayed. Random scan display is design to draw all the component lines of pictures 30 to 60 times per seconds. High-quality raster scan systems are capable of handling approximately 100,000 "short" lines at this refresh rate. A CRT beam in this system is adjusted in such a way that electron beam only hits the spot where the graphics is to be drawn. Thus the refresh rate in this system depends upon the number of lines to be displayed. A Pen plotter operates in a similar way and is an example of a random-scan system using hard-copy device.

Advantages of Random-Scan System:

1. Very high resolution, limited only by monitor.
2. Easy animation, just draw at different positions.
3. Requires little memory (just enough to hold the display program)

Disadvantages of Random-Scan System:

1. Requires intelligent electron beam i.e. processor controlled.
2. When the number of command in the buffer goes high the system take long time to process and draw pictures.
3. Cannot apply shading features.

DIFFERENCE BETWEEN RANDOM-SCAN DISPLAY AND RASTER-SCAN DISPLAY

Sr	RANDOM-SCAN DISPLAY	RASTER-SCAN DISPLAY
1.	It has high resolutions since the picture definition is stored as a set of line drawing commands and not as a set of intensity values.	It has less resolution than Random-scan display system.
2.	It produced smooth lines as the electron beam directly follows the line path.	It produced the zig-zag lines as the plotted values are discrete.
3.	Realism is difficult to achieve in this system.	High degree realism is achieved in picture with the aid of advanced shading and hidden surface technique.
4.	Random-scan systems are generally costlier.	Raster scan is easier and less expensive to implement than in random scan system.
5.	A vector system can draw continuous, smooth line (curves) from any point on the CRT face to other.	The raster system displays lines (curves) mathematically using various algorithms causing problems of "jaggering" or"staircasing".
6.	Random Scan System (devices) specially designed for Line drawing applications.	Raster Scan System (devices) specially designed for realistic shaded scene.
7.	Refresh rate of Random Scan System depends on the numbers of the lines to be displayed.	Refresh rate of Raster Scan System depends on the numbers of pixels scanned per second.
8.	It only draws lines and characters.	It draws all the complex picture areas with filled with colours or patterns.
9.	Picture definition is stored as a set of line drawing instructions.	Picture definition is stored as a set of intensity values for all screen points.

Some terms used in this chapter:

➢ Pixel:

Pixel is sometimes referred as Pel which stands for Pixel Element. Each screen point of the monitor or display system is known as a Pixel. Pixels are the basic building blocks of all the images.

➢ Scan conversion:

A major task of the display processor is digitizing a picture definition given in an application program into a set of pixel-intensity values for storage in the frame buffer. This digitization process is called scan conversion.

➢ Persistence:

Persistence is the one of the major property of phosphorous used in CRT's. It means how long they continue to emit light after the electron beam is removed. This term persistence is related to the CRT. A Phosphor's persistence is defined as the time from the removal of excitation to the movement when phosphorescence has decayed to 10 percent of the initial light output. It ranges from 10 to 60 microseconds. This light output decays exponentially with line. Lower persistence phosphors require higher refresh rates to maintain a picture on the screen without flicker. A phosphor with low persistence is useful for animation and a phosphor with high persistence is useful for displaying highly complex, static pictures. It ranges from 10-60 microseconds. So, persistence is the time it takes the emitted light from the screen to decay one tenth of its original intensity is called as persistence.

➢ Refresh rate:

This term Refresh rate is also related to the CRT. It is the number of times a display's image is repainted or refreshed per second. The refresh rate is expressed in hertz. A refresh of 75 means the image is refreshed 75 times in a second. The refresh rate for each display devices depends on the video card used. You can change the refresh rate in the display properties. However if you change the refresh rate to a setting that the display or video card cannot support, the display goes blank or the image becomes distorted. It is recommended to consult the display and video card manuals before changing the setting to determine the supported refresh rates.

Refreshing is needed for maintaining the picture on the screen. Refreshing of screen is done by keeping the phosphorus glowing to redraw the picture repeatedly. i.e. by quickly directing the electronic beam back to the same points.

➢ Resolution:

The maximum number of points that can be displayed without overlap on a CRT is referred to as the resolution. A more precise definition of resolution is the number of points per centimetre that can be plotted horizontally and vertically, although it often simply stated as the total number of points in each direction. The resolution of a CRT is dependent on the type phosphor, the intensity to be displayed, and the focusing and deflection systems. The maximum resolution is determined by the characteristics of the monitor and/or by the memory capacity available for storing the frame buffer. Typical resolution on high –quality systems is 1280 by 1024, with higher resolution available on many systems. . Typical resolutions are 640*480, 1024*768, and 1280*1024. The resolution or quantization of a sample value depends on the number of bits used in measuring the height of the waveform. An 8-bit quantization yields 256 possible values, 16-bit CD-qudra quantization results in over 65536 values.

➢ Aspect ratio:

This term Refresh rate is also related to the CRT. This is another property of the video monitors. This number gives the ratio of vertical points to horizontal points necessary to produce equal-length lines in both directions on the screen. Sometimes aspect ratio is stated in the terms of the ratio of horizontal to vertical points. An aspect ratio of ¾ means that a vertical line plotted with three points has the same length as a horizontal line plotted with four points. So, the aspect ratio is the ratio of vertical points to the horizontal points necessary to produce length of lines in both directions of the screen.

➢ Frame buffers:

Picture definition is stored in a memory area called frame buffer or refresh buffer. A frame buffer is a large, contiguous piece of computer memory. At a minimum, there is one memory bit for each pixel (picture element) in the raster. This amount of memory is called a bit plane or a bit map. Some graphics systems have a frame buffer memory distinct from main memory. The current trend is to have the

frame buffer accessible to the central processing unit (CPU) of the main computer. The number of rows in the frame buffer array equals the number of raster lines on the display screen. The number of columns in this array equals the number of pixels on each raster line.

- **What is rasterization?**

The process of determining the appropriate pixels for representing picture or graphics object is known as rasterization.

- **What is filament?**

In the CRT, heat is applied to the cathode by directing a current through a coil of wire, is called filament.

- What is antialiasing?

The process of adjusting intensities of the pixels along the line to minimize the effect of aliasing is called antialiasing.

- **What do you mean by retracing? Define horizontal as well as vertical retracing?**

At the end of each scan line, the electron beam returns to the left side of the screen to begin displaying the next scan line. The return to the left of the screen, after refreshing each scan line is called the horizontal retrace. And at the end of each frame, the electron beam returns to the top left corner of the screen to begin the next frame is called the vertical retrace.

- **Phosphor:**
  - The screen is coated with phosphor, 3 colors for a color monitor, 1 for monochrome.
  - For a color monitor, three guns light up red, green, or blue phosphors.
  - Intensity is controlled by the amount of time at a specific phosphor location.
  - The different properties of phosphorus: 1. Color 2. Persistence

UNIT: 3 2D GRAPHICS ALGORITHM

TWO-DIMENSIONAL GRAPHICS

2D Computer graphics is the computer based generation of digital images. It is also called two dimensional model and consists 2D geometric models, text & digital images and techniques specific to it. It is the creation, display and manipulation of object in the computer in two dimensions form. 2D computer graphics are mainly used in applications that were originally developed upon traditional printing and drawing technologies, such as typography(preparation of texts or look of printed matter), cartography(mapmaking: the science, skill or work of making map), technical drawing, advertising etc. In those applications, the two-dimensional image is not just a representation of a real-world object, but an independent artefact with added semantic value.

Raster Scan Graphics devices require special procedures to generate the display, to draw straight lines or curves and to fill polygons to give the impression of solid area.

Basic Output Primitives:

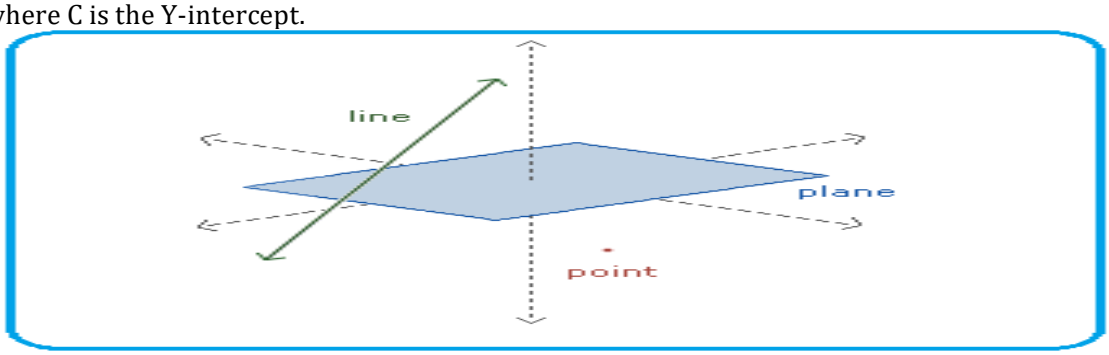
Primitives are basic element of computer program. It is a simple element of a computer program or graphic design from which larger programs or images can be constructed. Graphics programming packages provide functions to describe a scene in terms of these basic geometric structures. Each output primitive is specified with input coordinate data and other information about the way that object to be displayed points and straight lines segments are the simplest geometric components of picture. It is the responsibility of the graphics system or the application programs to convert primitives from its geometric definition into a set of pixels that makes up the primitive in the image space. This conversion process is called scan conversion.

Point:

Point is the basic building block of geometry. Point is zero-dimensional fixed location. A point is a mere location, location without width, breadth or length. Many physical objects suggest the idea of a point. Examples include the tip of a pencil, the corner of a cube, or a dot on a sheet of paper.

Line:

The word line can be used to refer to any stroke on paper, a line is usually considered to be straight, meaning that all of its points lie in a row. A line is basic concept of elementary geometry like a point. Line is a series of adjacent points that extends to infinity in two directions. Line in geometry is straight object which has no thickness and extends in both directions without end infinitely. Line is a geometrical object that is straight, infinitely long and infinitely thin. Lines are one-dimensional which have length but no width or depth. Two points are sufficient to define a line because one and only one line may be drawn through any pair of points. The line type, width and color are the attributes of the line. The line type includes solid line, dashed lines, and dotted lines. A line is of infinite extent can be defined by an angle of slope q and one point on the line P=P(x,y). This can also be defined as y=mx+c where C is the Y-intercept.



A line with a positive slope rises from left to right or runs uphill i.e. the value of y increases as **x**-increment or the value of y decreases as **x**-decrement. A line having a negative slope falls from left to right or runs downhill i.e. the value of **y** decreases as **x**-increment or **y** -increases as **x**-decrement. **x** and **y** are behaving in an inverse manners. The slope tells us at what rate the value of **y** changes relative to change in the value of **x**.

BASIC LINE DRAWING:

Line drawing is accomplished by calculating intermediate positions along the line path between two specified end point positions. An output device is then directed to fill in these positions between the endpoints. A line may have three forms with respect to slope i.e. it may have slope = 1 which shown in figure A, or may have slope >1 which shown in figure B, or it may have slope <1 as shown in figure C.

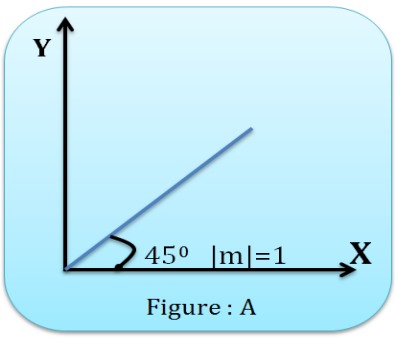


Figure : A

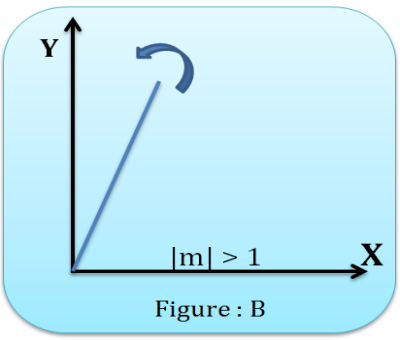


Figure : B

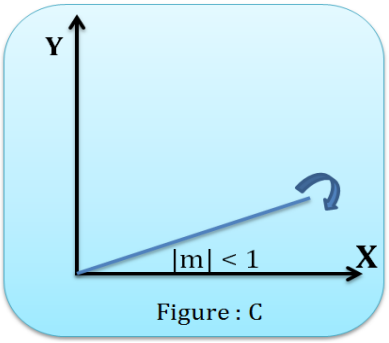


Figure : C

Now if a line has slope (m)=1, it is very easy to draw a line by simply starting from one point and go on incrementing the X and Y coordinates till they reach the second point. So that it is a simple case but if slope (m)<1 or slope (m)>1then there will be some problems. Lines are drawn by scan-converting all pixels between the given end points of a line. Various techniques and algorithms are developed for this purpose. These algorithms are listed below:

1. Incremental Line Algorithm
2. DDA Line Algorithm
3. Bresenham Line Algorithm

INCREMENTAL LINE ALGORITHM:

Incremental Line Drawing Algorithm is sometimes called as Direct Method. It is also called as Polynormal or Polynomial Method. This incremental line drawing algorithm, exploits simple line equation where the slope has different forms. The Cartesian slope equation of a straight line is **y= mx+c** where **m** is slope of th e straight line and **c**is y-intercept or interval point with y-axis.

Suppose A (x_1,y_1) and B (x_2,y_2) are two end points of required line segment. So, we first calculate the slope of a line with given formula.

$$\text{i.e.} \quad m = \tan\theta = \frac{\text{Perpendicular}}{Base} = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$$

For y-intercept (**c**) first term we can find with the formula:

$$c = y_1 - m\,x_1 \quad [\because \; y = mx+c\,]$$

we can draw a line by incrementing the **x-value** one unit from x_{start}= $x_1$to x_{end} = x_2 and step slope equation **y= mx+c** for the corresponding **y-value**. For each computed **(x , y)**coordinate value the corresponding pixel is illuminated byu invoking plot point **(x , y')**where **y'= round (y).**

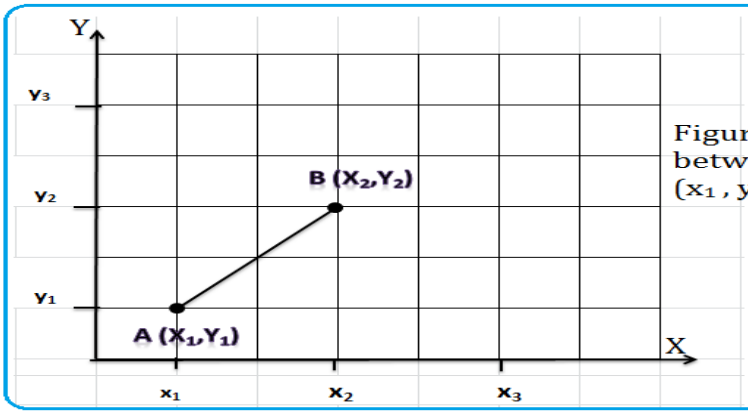


Figure is drawn to show the line path between two end point positions A (x_1 , y_1) and B(x_2 , y_2).

For given any **x-interval** Δx along with a line. we can compute the corresponding **y-interval** Δy from the above mentioned equation of the slope.

$$m = \frac{\Delta y}{\Delta x}$$

$$m.\Delta x = \Delta y$$

$$\therefore \quad \Delta y = m.\Delta x$$

Similarly, when we need Δx means **x-interval** then we can obtain the Δx corresponding to a specified Δy from above equation of the slope.

$$\text{i.e. } m = \frac{\Delta x}{\Delta y}$$

$$\Delta y = m.\Delta x$$

$$\frac{\Delta y}{m} = \Delta x$$

$$\therefore \boxed{\Delta x = \frac{\Delta y}{m}}$$

For the line with slope |m|< 1 :for this situation Δxcan be set unit /one increment to a small horizontal side and the corresponding vertical side is then set Δy as calculated from $\Delta y = m.\Delta x$.

For the line with slope |m|>1: for this situationΔycan be set unit/one increment to a small vertical side and the corresponding horizontal side is then calculated from $\Delta x = \Delta y.\frac{1}{m}$

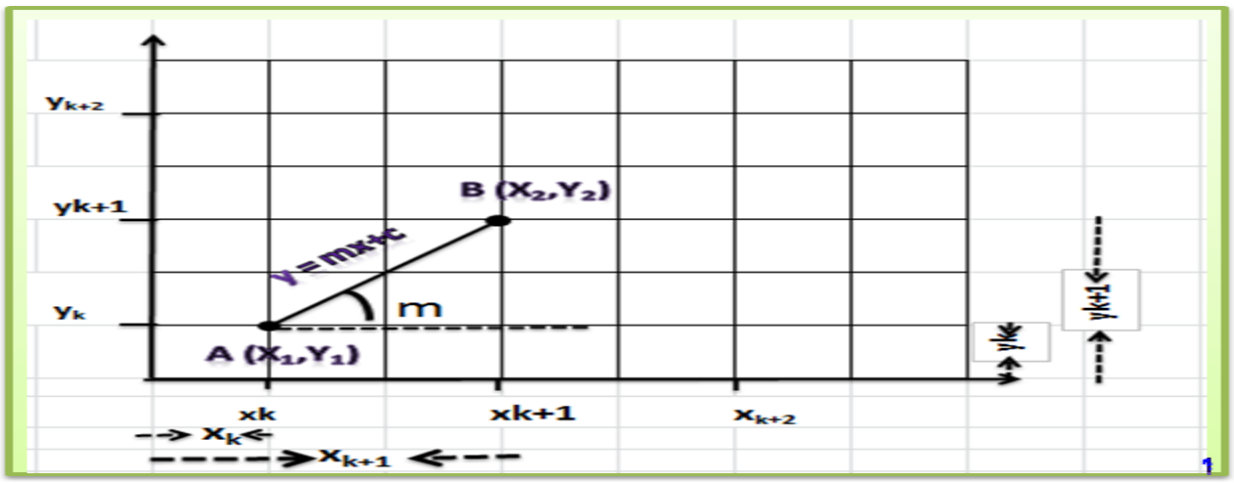
For the line with slope |m|=1:for this situation $\Delta x = \Delta y$ and then the horizontal Δx and vertical Δy both are incremented by 1.

DIGITAL DIFFERENTIAL ANALYZER ALGORITHM:

Digital Differential Analyzer Algorithm is an incremental line drawing procedure that is easy to produce reasonable lines. DDA is used in drawing straight line to form a line, triangle or polygon in computer graphics. This method based on the fact that the slope of a line is constant at all points of a line. Digital differential analyzer is the application of analyzer in digital form which is accurate and fast. Differential analyzer is used to make lines between two points so that a straight line or polygon with n number of sides can be seen on the screen. Distance between two points or a pixel is described by a differential equation where coordinates of the starting point and that of ending points are specified in the software.

DDA is used in the design of the straight line to form a line, a triangle or a polygon in computer graphics. DDA makes analysis of samples along the line at regular intervals of one coordinate as an integer and other coordinate is round of as an integer that is closest to the line. So as the line progresses it scans the first coordinate of integer and round the second to the nearest whole number. So a line using the DDA for x coordinate it will be x0 to x1, but for y coordinate it will be y=mx+ c and to draw function it will be Fn(x, y rounded off).

DDA algorithm samples a line at unit interval (next value incremented by 1) in one coordinates and determines corresponding integer value nearest the line path for other coordinate according to the slope position.



We know that the equation of the Cartesian slope of the straight line that is **y = mx + c** where **m** is the slope of the line and **c** is y-intercept.

Suppose we have two end points of the line (x_1,y_1) and (x_2,y_2) then the slope of the line can be shown as:

$$\text{i.e. } m = \text{Tan}\,\theta = \frac{\text{Perpendicular}}{Base} = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\boxed{c = y_1 - m\,x_1}$$

[For the first term]

The next value for the (x , y) can be plotted according the slope (m) position and calculated as above mentioned conditions:

CASE: 1 If slope |m| < 1 :

We sample the line at unit **x-interval** i.e. $\Delta x = 1$ and compute each successive value for y.

So,

$x_{k+1} = x_k + 1$

$y_{k+1} = y_k + m$ ----------(I)

Here, K takes integer value starting from 1 and increases by 1 (unit) until reaching the endpoint. x_{K+1} is next incremented value of x.

$x_{k+1} = x_k + 1$

$x_{k+1} - x_k = 1$

$\Delta x = 1$ [because $x_{k+1} - x_k = \Delta x$]

$$m = \frac{\Delta y}{\Delta x}$$

$$m = \frac{y_{k+1} - y_k}{x_{k+1} - x_k}$$

$$m = \frac{y_{k+1} - y_k}{1}$$

$$m = y_{k+1} - y_k$$

$$\therefore y_{k+1} = y_{k+m}$$

CASE: 2 If slope |m| > 1 :

We sample the line at unit **y-interval** i.e. $\Delta y = 1$ and compute each successive value for x correspondingly.

So,

$$x_{k+1} = x_k + \frac{1}{m}$$ ----------(II)

$y_{k+1} = y_k + 1$

(Here, y_{K+1} is next incremented value of y)

$y_{k+1} = y_k + 1$

$y_{k+1} - y_k = 1$

$\Delta y = 1$ [because $y_{k+1} - y_k = \Delta v$]

We know that,

$$m = \frac{y_{k+1} - y_k}{x_{k+1} - x_k}$$

$$m = \frac{1}{x_{k+1} - x_k}$$

$$m.(x_{k+1} - x_k) = 1$$

$$(x_{k+1} - x_k) = \frac{1}{m}$$

$$\therefore x_{k+1} = x_k + \frac{1}{m}$$

CASE: 3 If slope |m| = 1 :

In this condition we sample the line at unit increment for both successive value x, and y because slope is constant 1 i.e. $\tan 45^0$.

So,

$x_{k+1} = x_k + 1$

$y_{k+1} = y_k + 1$ ---------- **(III)**

ADVANTAGES OF DDA ALGORITHM:

1. DDA algorithm is a faster method for calculating pixel positions than the direct method.
2. Appropriate increment are applied in the x or y (axis) direction to step pixel positions along the line path.
3. The general principal behind DDA algorithm for outputting line primitives of any shape is the slope of a line is constant at all points on a line.

DISADVANTAGES OF DDA ALGORITHM:

1. DDA algorithm drift away from the actual line because of rounding off float value to integer.
2. It causes jaggies or stair-step effect.
3. Rounding operations and floating-point arithmetic in procedure are still time-consuming.

BRESENHAM'S LINE ALGORITHM:

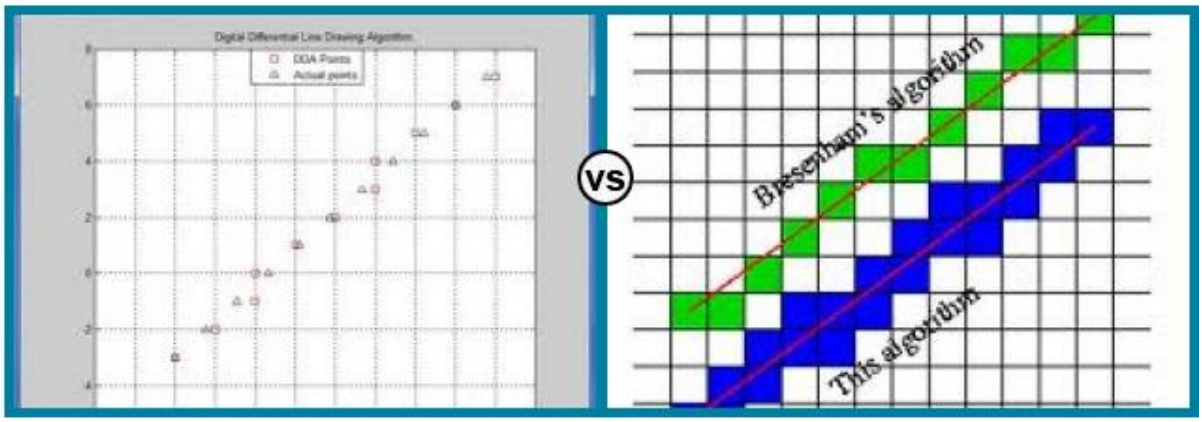
Bresenham Algorithm was developed by J.E. Bresenham in 1962 and it is much accurate and more efficient than DDA. It scans the coordinates but instead of rounding them off it takes the incremental value in account by adding or subtracting and therefore can be used for drawing circle and curves. Therefore if a line is to be drawn between two points x and y then next coordinates will be (x_k+1,y_k) and (x_k+1, y_k+1) where k is the incremental value of the next coordinates. And difference between these two will be calculated by subtracting or adding the equations formed by them.

Advantages of Brensenhams' algorithm

- Efficient line drawing algorithm using only incremental integer calculations
- Can be adapted to draw circles and other curves
- Principles:
  - Vertical axes show scan line positions
  - Horizontal axes show show pixel columns
  - At each step, determine the best next pixel based on the sign of an integer parameter whose value is proportional to the difference between the vertical separations of the two pixel positions from the actual line.

Difference between DDA and BLA:

SN	DDA	BLA
1.	DDA uses floating points.	Bresenham algorithm use fixed points.
2.	DDA round off the coordinates to nearest integer.	Bresenham algorithm does not round off the coordinates to nearest integer.
3.	DDA algorithm is less accurate and efficient than BLA.	Bresenham algorithm is much accurate and efficient than DDA.
4.	DDA uses multiplication and division of equation.	Bresenham algorithm uses subtraction and addition only.
5.	DDA algorithm is rather **slow**ly than Bresenhams algorithm in line drawing.	Bresenhams algorithm is faster than DDA algorithm in line drawing.
6.	DDA algorithm uses an enormous number of floating-point multiplications so it is expensive.	Bresenhams algorithm is less expensive than DDA algorithm as it uses only addition and subtraction.



Difference Between DDA and Bresenham Algorithm

Mid-Point Circle Algorithm:

Midpoint circle algorithm is an algorithm used to determine the points needed for drawing a circle.Circle is a frequently used component in pictures and graphs.

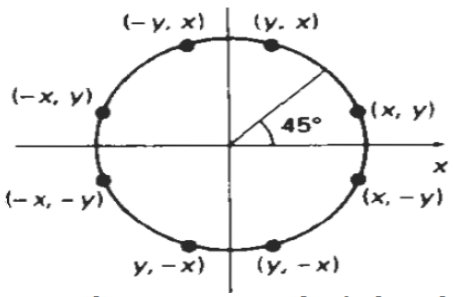


Figure to show Symmetry of a circle. Calculation of a circle point (x, y) in one octant yields the circle points for other seven octants.

Center Position : (xc , yc)
Distance : r (Radius)
This distance relationship is expressed by the Pythagorean theorem in Cartesian coordinates as
(x – xc)2 + (y – yc)2 = r2
the above equation can be used to calculate the successive y values by stepping x values as

y = yc ± Ö r2 – (xc – x)2

but in this method, the computation time is high and spacing between pixels is not uniform. One way to eliminate the unequal spacing is to calculate points using polar coordinates r and q.

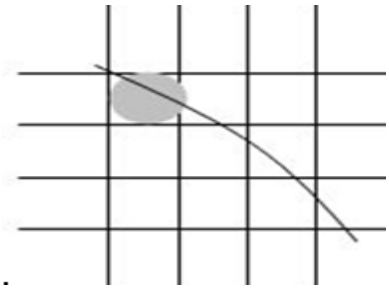
x = xc + r cos q

y = yc + r sin q

the step size for q value depends on the display device.

Computations can be reduced by considering the symmetry of circles. The shape of the circle is similar in each quadrant, more over in each octant also. Once the pixel positions at one octant is calculated its reflection can also be obtained as shown in the figure.

In these cases, the computation time is high. To reduce the computation time the midpoint algorithm used for circle drawing.
Screen Center Point : (xc , yc)
Calculate Pixel Position : (x, y)



Screen Posisotn Adding :
xc = xc + x
yc = yc + y

The circle function is defined as:
¦circle (x,y) = x2 + y2 – r2

any point (x,y) on the boundary of the circle with radius r satisfies the equation ¦circle(x,y)=0, that is

¦circle (x,y) = < 0, if (x,y) is inside the circle boundary
= = 0, if (x,y) is on the circle boundary
> 0, if (x,y) is outsider the circle boundary

the relative position of any point can be determined by checking the sign of the circle function.

Sampling Position :
(xk , yk)
Next Determine,
(xk+1, yk) or (xk+1, yk-1)
The circle function tests in the above equation are performed for the midpoints between pixels near the circle path at each sampling step. The figure shows the midpoint between two pixels. Assuming we have just plotted the pixel at (xk,yk). We next need to determine whether the pixel at position (xk+1, yk) or the one at position (xk+1, yk-1) is closer to the circle. The decision parameter is calculated as

pk = ¦circle (xk+1, yk – ½)
= (xk+1)2 + (yk- ½)2 – r2

if pk > 0, this midpoint is inside the circle and the pixel on scan line yk is closer to the circle boundary.

Otherwise, the mid-position is outside or on the circle boundary, and we select the pixel on scan-line yk-1.

Successive decision parameters are obtained using incremental calculations. P

pk+1 = ¦circle (xk+1 + 1, yk+1 – ½)
= [(xk+1) + 1]2 + [yk+1 – ½]2 – r2

or pk+1 = pk + 2(xk+1) + (yk+12- yk2) – (yk+1 – yk) + 1

where yk+1 is either yk or yk-1, depending on the sign of pk.
Increments for obtaining pk+1 are either 2xk+1 + 1 (if pk is negative) or 2xk+1 + 1 – 2yk+1. Evaluation of the terms 2xk+1 and 2yk+1 can also be done incrementally as

2xk+1 = 2xk + 2
2yk+1 = 2yk – 2

Two Terms (0,r) and (0,2r)
Each successive value is obtained by adding 2 to the previous value of 2x and subtracting 2 from the previous value of 2y.

The initial decision parameter is obtained by evaluating the circle function at the start position (x0,y0) = (0,r):
p0 = ¦circle (1, r- ½)
= 1 + (r- ½)2 – r2
(or) p0 = 5/4 – r

if the radius r is specified as an integer, we can simply round p0 to
p0 = 1 – r (for r an integer)
since all increments are integers.

The steps involved in the midpoint circle algorithm as follows:

1. Input radius r and circle centre (xc,yc), and obtain the first poitn on the circumference of a circle centered on the origin as (x0,y0) = (0, r).
2. Calculate the initial value of the decision parameter as p0 = 5/4 – r
3. At each xk position, starting at k=0, perform the following test: if pk < 0, the next point along th e circle
   centered on (0,0) is (xk+1, yk) and p:
   pk+1 = pk + 2xk+1 + 1
   otherwise, the next point along the circle is (xk+1, yk-1) and
   pk+1 = pk + 2xk+1 + 1 – 2yk+1 where
   2xk+1 = 2xk + 2; and 2yk+1 = 2yk - 2
4. Determine symmetry points in the other seven octants.
5. Move each calculated pixel position (x,y) onto the circular path cetered on (xc,yc) and plot the coordinate values. x = x + xc, y = y + yc
6. Repeat steps 3 through 5 until x >= y.

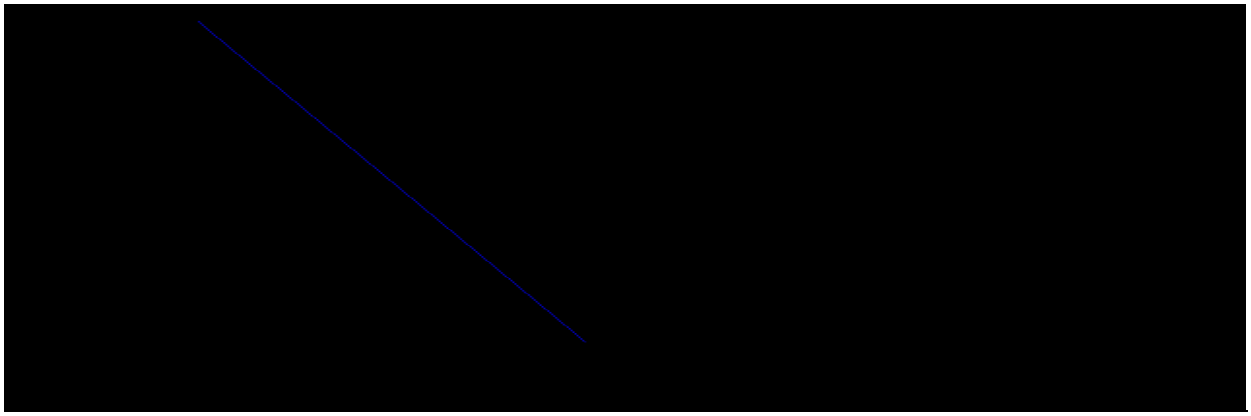
Different Cprograms for Above Algorithms:

/*C program to show the Digital Differential Analyzer (DDA) Algorithm*/

```
#include<stdio.h>
#include<conio.h>
#include<math.h>
#include<graphics.h>
main()
{
float x,y,x1,y1,x2,y2,dx,dy,pixel;
int i,gd,gm;
printf("Enter the value of x1,y1 : ");
scanf("%f %f",&x1,&y1);
printf("Enter the value of x2,y2 : ");
scanf("%f %f",&x2,&y2);
detectgraph(&gd,&gm);
initgraph(&gd,&gm," ");
dx=abs(x2-x1);
dy=abs(y2-y1);
if(dx>=dy)
pixel=dx;
else
pixel=dy;
dx=dx/pixel;
dy=dy/pixel;
x=x1;
y=y1;
i=1;
while(i<=pixel)
{
putpixel(x,y,1);
x=x+dx;
y=y+dy;
i=i+1;
delay(100);
}
getch();
closegraph();
}
```

Output Screen:

```
Enter the value of x1,y1  : 100 20
Enter the value of x2,y2  : 300 400
```



/*C program to show the BLA LINE ALGORITHM*/

```
# include <stdio.h>
# include <conio.h>
# include <graphics.h>
void main()
{
int dx,dy,x,y,p,x1,y1,x2,y2;
int gd,gm;
clrscr();
printf("\n\n\tEnter the co-ordinates of first point : ");
scanf("%d %d",&x1,&y1);
printf("\n\n\tEnter the co-ordinates of second point : ");
scanf("%d %d",&x2,&y2);
dx = (x2 - x1);
dy = (y2 - y1);
p = 2 * (dy) - (dx);
x = x1;
y = y1;
detectgraph(&gd,&gm);
initgraph(&gd,&gm,"e:\\tc\\bgi");
putpixel(x,y,WHITE);
while(x <= x2)
{
if(p < 0)
{
x=x+1;
y=y;
p = p + 2 * (dy);
}
else
{
x=x+1;
y=y+1;
p = p + 2 * (dy - dx);
}
putpixel(x,y,WHITE);
}
getch();
closegraph();
}
```

/*Circle Algorithm Using C Programming*/

```
#include<stdio.h>
#include<conio.h>
#include<graphics.h>
void main()
{
   int gd=DETECT,gm;
   int x,y,r;
   void cir(int,int,int);
   printf("Enter the Mid points and Radious:");
   scanf("%d%d%d",&x,&y,&r);
   initgraph(&gd,&gm,"");
   cir(x,y,r);
   getch();
   closegraph();
}

void cir(int x1,int y1,int r)
{
   int x=0,y=r,p=1-r;
   void cliplot(int,int,int,int);
   cliplot(x1,y1,x,y);
   while(x<y)
  {
      x++;
      if(p<0)
        p+=2*x+1;
      else
      {
        y--;
        p+=2*(x-y)+1;
      }
      cliplot(x1,y1,x,y);
  }
 }
void cliplot(int xctr,int yctr,int x,int y)
{
  putpixel(xctr +x,yctr +y,1);
  putpixel(xctr -x,yctr +y,1);
  putpixel(xctr +x,yctr -y,1);
  putpixel(xctr -x,yctr -y,1);
  putpixel(xctr +y,yctr +x,1);
  putpixel(xctr -y,yctr +x,1);
  putpixel(xctr +y,yctr -x,1);
  putpixel(xctr -y,yctr -x,1);
  getch();
}
```

UNIT: 4 2D GRAPHICS TRANSFORMATIONS & VIEWING

1. 2D TRANSFORMATION:

Transformation is the backbone of Computer graphics which enables us to manipulate the shape, size and location of the object. 2D Transformation is the process of manipulating the coordinates or position, orientation and size of any object. This is also called geometric transformation. All of these transformations can be efficiently and succinctly handled by using some simple matrix representations.

In all the Computer Graphics there is facility to move an object, rotate an object and translate an object. 2D or Two Dimensional is that which provides these rotations those are based on mathematical forms and there are two types of movements of object. First those are also known as geometric transformation and co-ordinate transformation. Geometric transformations have numerous applications in geometric modelling, e.g., manipulation of size, shape, and location of an object.
In this Object is moved on the coordinate system or background. In other words when an object moves to his axis while the background is fixed for example when a car moves on stable road this is called as Geometric System when object is fixed and background moves then it is called as Coordinate System. For example in many movies we can see the car which is running fast on the road this is not truth. In this instead moving a car a background move across the car. In CAD, transformation is also used to generate surfaces and solids by sweeping curves and surfaces, respectively. The term "sweeping" refers to parametric transformations, which are utilized to generate surfaces and solids. When we sweep a curve, it is transformed through several positions along or around an axis, generating a surface

There are two types of transformations:

Modelling Transformation:
This transformation alters the coordinate values of the object. Basic Operations are scaling, translation, rotation and, combination of one or more of these basic transformations. Examples of these transformations can be easily found in any commercial CAD software. For instance, AutoCAD uses SCALE, MOVE, and ROTATE commands for scaling, translation, and rotation transformations, respectively.

Visual Transformation:
In this transformation there is no change in either the geometry or the coordinates of the object. A copy of the object is placed at the desired sight, without changing the coordinate values of the object. In AutoCAD, the ZOOM and PAN commands are good examples of visual transformation.

Calculations see in handwritten notes: ----------
---

2. COMPOSITE TRANSFORMATION:

A composite transformation is a sequential process of various combined transformation operations in which one operation is followed by another operation. We can set up a matrix for any sequence of transformation operations as a composite transformation matrix by calculating the matrix product of individual transformations. Forming products of transformation matrices is often referred to as a composition of matrices or concatenation of matrices. For column-matrix representation of coordinate positions, we form composite transformations by multiplying matrices in order from right side to left. Each successive transformation matrix pre-multiplies the product of the preceding transformation matrices.

3. HOMOGENEOUS COORDINATE:

Matrix representation is the standard method of representing transformation in computer graphics system. The term homogeneous is used in mathematics to refer to the effect of representation on cartesian equations. Homogeneous coordinates are the ways to represent points to simplify to express affine transformations. Homogeneous coordinates have a range of applications in computer graphics where they allow affine transformation and projective transformation to be easily represented by a matrix. So, to treat all the transformations in the same manner, homogeneous coordinates are used for representation.

To express any two dimensional transformation as a matrix manipulation, we represent a point (x.y) with the homogeneous coordinates (x_h,y_h,h) where h is called homogeneous factor which takes positive values.

so, $x=x_h/h$ and $y=y_h/h$

So, the homogeneous coordinate triplet is (x.h,y.h,h).If we take h=1 then the homogeneous coordinate for the point (x,y) becomes (x,y,1). So, mainly homogeneous coordinates are used to compute the factors by changing it matrix from 2x2 to 3x3 or 4x4 and so on. Finally we know that the need of homogeneous coordinate is to perform more than one transformation at a time. They reduce the unwanted calculations, intermediate steps, save time and memory and produce a sequence of transformations. Expressing positions in homogeneous coordinates allow us to represent all the geometric transformations equations as matrix multiplications.

Representation of several matrices into homogeneous form:

Translation:

$$\begin{pmatrix} 1 & 0 & t_x \\ 0 & 1 & t_y \\ 0 & 0 & 1 \end{pmatrix}$$

Inverse Translation:

$$\begin{pmatrix} 1 & 0 & -t_x \\ 0 & 1 & -t_y \\ 0 & 0 & 1 \end{pmatrix}$$

Rotation:

$$\begin{pmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

Inverse Rotation:

$$\begin{pmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

Scaling:

$$\begin{pmatrix} s_x & 0 & 0 \\ 0 & s_y & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

Inverse Scaling:

$$\begin{pmatrix} 1/s_x & 0 & 0 \\ 0 & 1/s_y & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

4. TWO DIMENSIONL OBJECT TO SCREEN VIEWING TRANSFORMATION:

2-Dimensional Viewing Pipeline:

A graphical package allows a user to specify which part of the defined picture is to be displayed and where that part is to be placed on the display device. Any convenient Cartesian coordinate system; referred to as the world co ordinate reference frame can be used to define the picture. For a 2-D picture, a view is selected by specifying a subarea of the total picture area. A user can select single area for displaying or several areas could be selected for simultaneous display. The picture parts within the selected areas are then mapped onto specified areas of the device co-ordinates. When the multiple view areas are selected, these areas can be placed in separate display locations or some areas could be inserted into other, larger display area. Transformations from world to device coordinates involve translation rotation and scaling operations, as well as procedures for deleting those parts of the picture that are outside the limits of a selected display area. A world co-ordinate area selected for display is called a window. An area on the display device to which a window is mapped is called a view p ort. The window defines what is to be viewed. The viewport defines where it is to be displayed. Often, windows and viewports are rectangles in standard positions, if the rectangle edges are parallel to the co-ordinate axis. "The mapping of a port of a world co-ordinate scene to a device co-ordinate is referred to as viewing transformation." Sometimes, the 2D viewing transformation is simply referred to as the window – to – viewport transformation or the windowing transformation.

Figure is shown below to illustrate the mapping of picture selections that fall within a rectangular window onto a designated rectangular viewpoint.

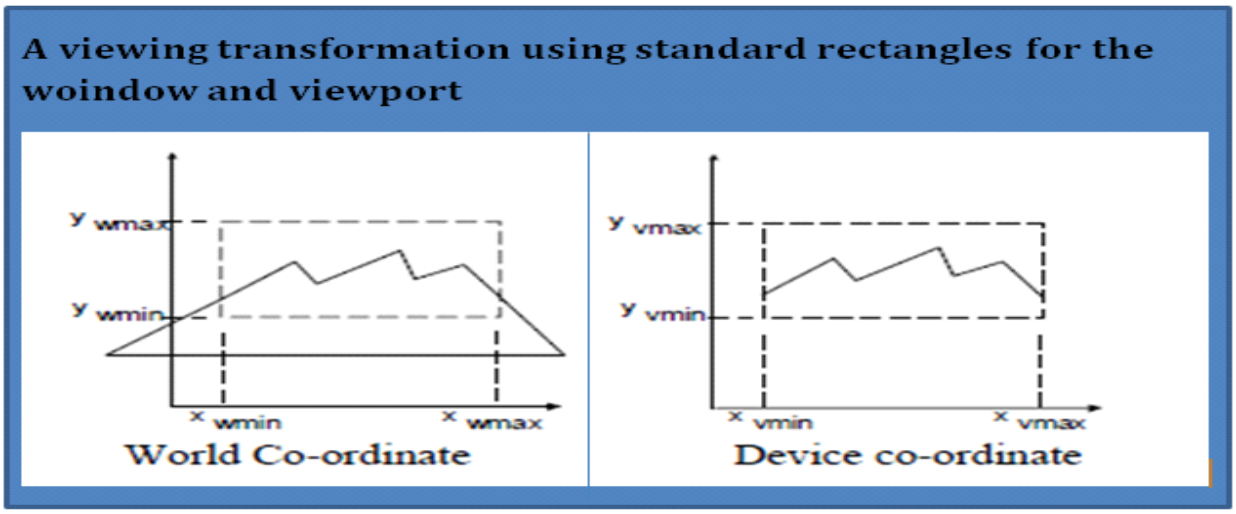


Figure: A viewing transformation using standard rectangles for the window and viewpoint.

Steps to be followed for window to viewpoint transformations area:

- Generate world co-ordinate
- Convert world co-ordinate to view co-ordinate.
- Map the view co-ordinate to normalized viewing coordinate.
- Map the normalized viewing co-ordinate to device coordinate system.
-

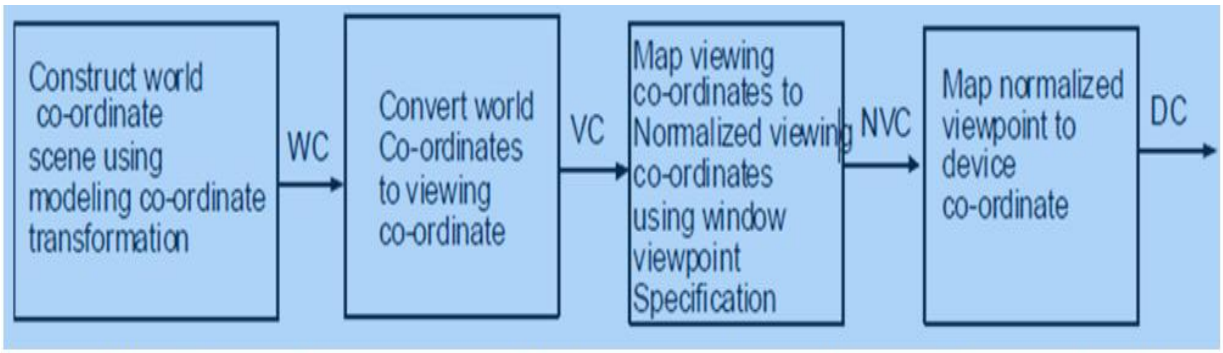


Fig. The two dimensional viewing transformation pipeline

5. 2D WINDOW TO VIEW PORT MAPPING:

The world co-ordinate selected for display is called window. The area on the display device to which window is mapped is called viewport. So, window defines what is to be viewport defines wher e it is to be displayed. The mapping of part of world co-ordinate scene to device co-ordinate is called viewing transformation or window-to-viewport transformation.

Window – to – viewport transformation can be explained as following terms:

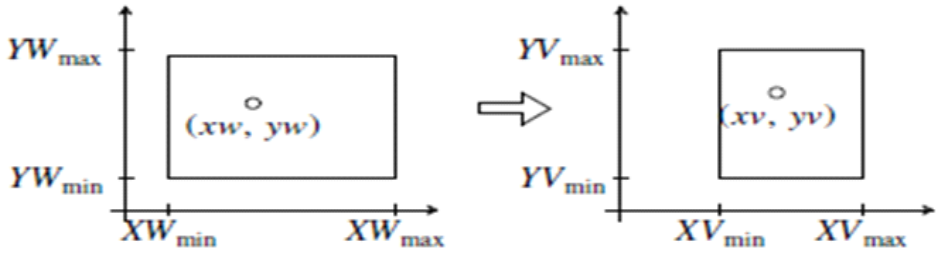
- Choose the world co-ordinate in a rectangle.
- Transform it to origin.
- Scale it with appropriate value.

Transform it to the relative position in viewport.

- Step 1: T (-xwmin, -ywmin)
- Step:2: S (sx, sy)
- Step:3: T(xvmin, yvmin)

∴ Net transformation,

Twv = T (xvmin, yvmin). S(sx, sy).T(-xwmin, -ywmin)



$$xv = xv_{min} + (xw - xw_{min})sx$$

$$yv = yv_{min} + (yw - yw_{min})sy$$

sx and sy are scaling factors

$$sx = \frac{xv_{max} - xv_{min}}{xw_{max} - xw_{min}}, \qquad sy = \frac{yv_{max} - yv_{min}}{yw_{max} - yw_{min}}$$

6. CLIPPING:

Clipping is the procedure that identifies these portions of the picture that are either inside or outside of the specified region of span. Applications of clipping include extracting part of a detained scene for viewing ,identifying visible surfaces in three-dimensional views, antialiasing line segments or object boundaries, creating objects using solid-modelling procedures, displaying a multi-window environment , and drawing and painting operations that allow parts of a picture to be selected for copying, moving, erasing, or duplicating.

Depending on the application, the clip window can be a general polygon or it can even have curved boundaries. We first consider clipping methods using rectangular clip regions then we discuss methods for other clip-region shapes.

Applications of clipping:

1. Extracting part parts of a defined scene for viewing.
2. Identifying visible surface in 3-Dimensional views.
3. Displaying a multi-window environment.
4. Drawing and painting operation that allows parts of a picture to be selected for copying, moving, erasing, or duplicating.

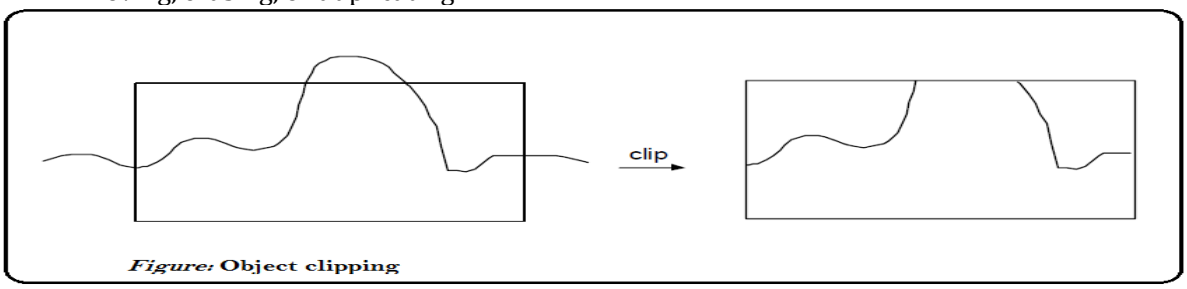


Figure: Object clipping

Types of clipping:

Line and polygon clipping routines are standard components of graphics packages, but many packages accommodate curved objects, particularly spline curves and conics, such as circles and ellipses. Another way to handle curved objects is to approximate them with straight-line segments and apply the line- or polygon clipping procedure.

- Point Clipping
- Line Clipping (straight-line segments)
- Area Clipping (polygons)
- Curve Clipping
- Text Clipping

Point clipping:

Assuming that the clip window is a rectangle in standard position, we save a point P = **(x, y)** for display if the following inequalities are satisfied:

$$xw_{min} \leq x \leq xw_{max}$$

$$yw_{min} \leq y \leq yw_{max}$$

where the *edges of* the clip window $(xw_{min}, xw_{max}, yw_{min}, yw_{max})$ can be either the world-coordinate window boundaries or view port boundaries. If any one of these four inequalities is not satisfied, the point is clipped (not saved for display). Although point clipping is applied less often than line or polygon clipping, some applications may require a point clipping procedure. For example, point clipping can be applied to scenes involving explosions or sea foam that are modelled with particles (points) distributed in some region of the scene.

LINE CLIPPING:

Figure shown below illustrates possible relationships between line positions and a standard rectangular clipping region. A line clipping procedure involves several parts. First, we can test a given line segment to determine whether it lies completely inside the clipping window. If it does not, we try to determine whether it lies completely outside the window. Finally, if we cannot identify a line as completely inside or completely outside, we must perform intersection calculations with one or more clipping boundaries. We process lines through the "inside-outside" test by checking the line endpoints.

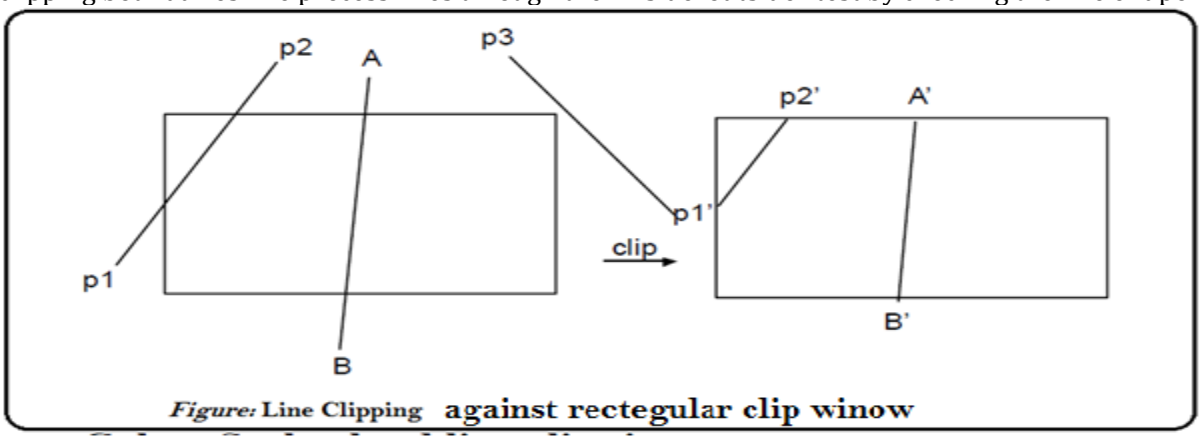


Figure: Line Clipping against rectegular clip winow

Cohen Sutherland line clipping:

Cohen Sutherland line clipping is an oldest and most popular algorithm that speeds up the processing of the line segments by performing initial tests that reduce the number of intersections that must be calculated. In this method, every line endpoint is assigned a four digit binary code which is called as region code that identifies the location of the point relative to the boundaries. Regions are set up in reference to the boundaries as shown in the figure below. Each bit position in the region code is used to indicate one of the four relative coordinate positions of the point with respect to the clip window: to the left, right, top or bottom.

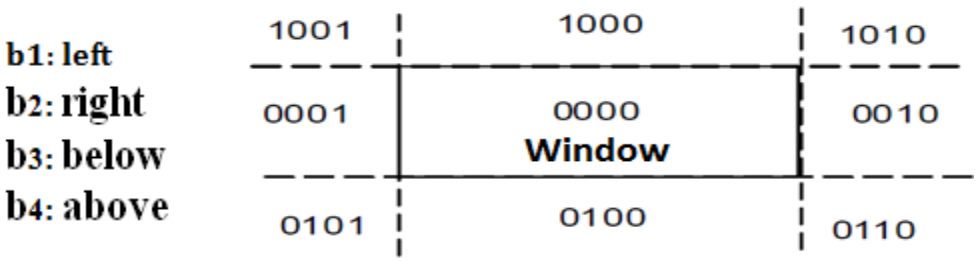
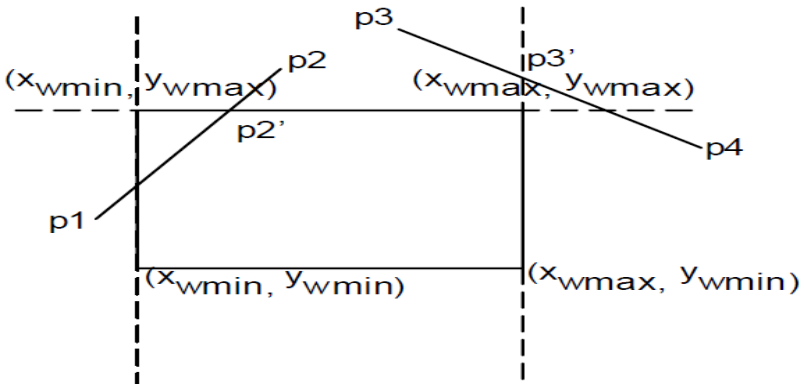


Figure to show binary region codes assigned to line endpoints according to relative position with respect to the clipping rectangle.



The value 1 indicates its relative position. If a point is within clipping rectangle then region code is 0000. So,

$$\text{If } x - x_{wmin} < 0 \text{ , } b_1 = 1$$
$$\text{If } x_{wmax} - x < 0 \text{ , } b_2 = 1$$
$$\text{If } y - y_{wmin} < 0 \text{ , } b_3 = 1$$
$$\text{If } y_{wmin} - y < 0 \text{ , } b_4 = 1$$

If the region codes of both end points are 0000 then we accept the line. Any line that has one in the same bit position is rejected i.e.
if $\mathbf{R_A}$ **and** $\mathbf{R_B \neq 0}$ then line is completely outside.

The lines which con not be identified as completely inside or outside a window by these tests are checked for intersection with the window boundary. Such lines may or may not cross into the window interior.
In the figure aside, region code of
P_1= 0001
P_2= 1000
P_1 AND P2= 0
So we need further calculation. Starting form p1, intersection of P1 with left boundary is calculated.
Region code of P1' = 0000 **P_1' AND P_2= 0.**
Intersecting of P2 with above boundary is calculated region code of P2' = 0000
Since both end points have region codes (0000). So P_1', P_2' portion of the line is saved. Similarly, for P_3, P_4.
P_3 = 1000
P_4 = 0010
P_3 AND P_4 = 0
So we need further calculations; starting from P_3 region code of P_3 is 1000, i.e b_4 is high, so intersection of P_3 with upper boundary which yields P_3' having region code 1010.
Again p_3' AND $P_4 \neq 0$
So P_3P_4 is totally clipped.
The intersection point with vertical boundary can be obtained by

$$y = y_1 + m(x - x_1)$$

Where (x_1,y_1) and (x_2,y_2) are end points of line and y is the co-ordinate value of intersection point where x value is either x_{wmin} or x_{wmax} and $m = y_2 - y_1 / x_2 - x_1$.
Similarly , intersection point with horizontal boundary

$$x = x_1 + (y - y_1)/m$$

Where , $y = y_{wmin}$ or y_{wmax}

UNIT: 5 3D GRAPHICS

1. INTRODUCTION TO 3D GRAPHICS:

3D computer graphics in contrast to 2D computer graphics are graphics that use a three-dimensional representation of geometric data that is stored in the computer for the purposes of performing calculations and rendering 2D images. Such images may be for later display or for real-time viewing. Despite these differences, 3D computer graphics rely on many of the same algorithms as 2D computer vector graphics in the wire frame model and 2D computer raster graphics in the final rendered display. In computer graphics software, the distinction between 2D and 3D is occasionally blurred; 2D applications may use 3D techniques to achieve effects such as lighting, and primarily 3D may use 2D rendering techniques. In computer graphics software, 2D applications may use 3D techniques to achieve effects such as lighting, projection and primarily 3D may use 2D rendering techniques. Any point on a 3D object is represented by 3 co-ordinates x, y , z where z is usually refers to the depth.The extra dimension brings with it a host of complexities such as lighting and viewing projections. The 3D viewing process is inherently more complex then is the 2D viewing process. The examples of 3D viewing devices are Stereoscopic systems, Virtual reality systems etc.

2. NON-PLANNER SURFACE:

Beizer Curve:

A Bezier curve is a Parametric curve frequently used in computer graphics and related fields. Bezier curves were widely publicized in 1962 by the **French engineer Pierre Bezier,** who used them to design automobile bodies. The curves were first developed in 1959 by **Paul de Castelijau** using de Casteliju's algorithm, a numerically stable method to evaluate Bezier curves.

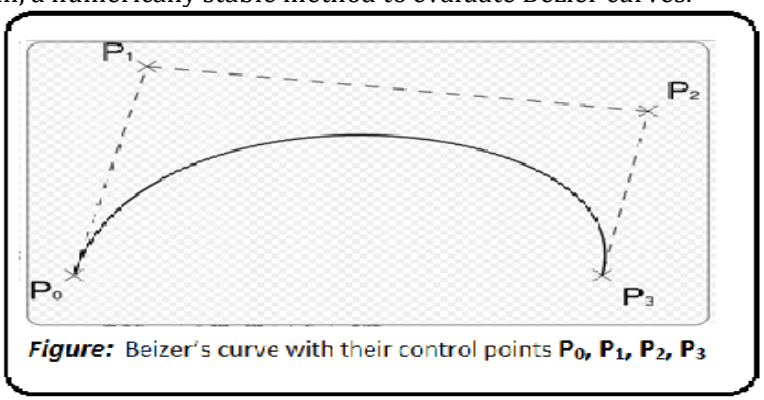


Figure: Beizer's curve with their control points **P_0, P_1, P_2, P_3**

s

In the above figure four points P_0, P_1, P_2 and P_3 in the plane or in three-dimensional space define a cubic Bezier curve.

Bezier curves are defined using four control points, known as knots. Two of these are the end points of the curve, while the other two effectively define the gradient at the end points. The Bezier form of the cubic polynomial curve segment, named after Pierre Bezier, indirectly specifies the endpoint tangent vector by specifying two intermediate points that are no on the curve. Bezier curves are defined using four control points, known as knots. Two of these are the end points of the curve, while the other two effectively define the gradient at the end points. These two points control the shape of the curve. The curve is actually a blend of the knots.

The diagram above shows a Bezier curve with their control points. In the above figure four points $\mathbf{P}_0$, $\mathbf{P}_1$, $\mathbf{P}_2$ and $\mathbf{P}_3$ in the plane or in three-dimensional space define a cubic Bezier curve. The curve starts at $\mathbf{P}_0$ going toward $\mathbf{P}_1$ and arrives at $\mathbf{P}_3$ coming from the direction of $\mathbf{P}_2$. Usually, it will not pass through $\mathbf{P}_1$ or $\mathbf{P}_2$; these points are only there to provide directional information. The distance between $\mathbf{P}_0$ and $\mathbf{P}_1$ determines "how long" the curve moves into direction $\mathbf{P}_2$ before turning towards $\mathbf{P}_3$. Writing $\mathbf{B}_{\mathbf{P}_i,\mathbf{P}_j,\mathbf{P}_k}(t)$ for the quadratic Bezier curve defined by points $\mathbf{P}_i$, $\mathbf{P}_j$, and $\mathbf{P}_k$, the cubic Bezier curve can be defined as a linear combination of two quadratic Bezier curves:

$$\mathbf{B}(t) = (1-t)\mathbf{B}_{\mathbf{P}_0,\mathbf{P}_1,\mathbf{P}_2}(t) + t\mathbf{B}_{\mathbf{P}_1,\mathbf{P}_2,\mathbf{P}_3}(t) \ , \ t \in [0,1].$$

The explicit form of the curve is:

$$\mathbf{B}(t) = (1-t)^3\mathbf{P}_0 + 3(1-t)^2 t\mathbf{P}_1 + 3(1-t)t^2\mathbf{P}_2 + t^3\mathbf{P}_3 \ , \ t \in [0,1].$$

For some choices of $\mathbf{P}_1$ and $\mathbf{P}_2$ the curve may intersect itself, or contain a cusp.

Important properties of Bezier Curve:

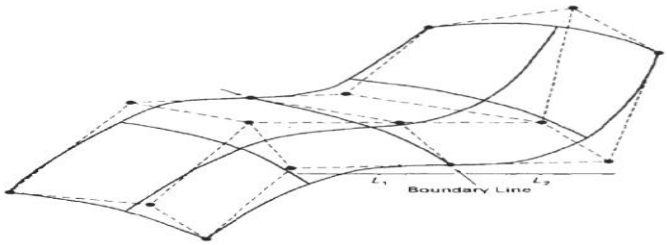
- It needs only four control points
- It always passes through the first and last control points

- The curve lies entirely within the convex half formed by four control points.

Bezier surfaces:

Generalizations of Bezier curves to higher dimensions are called Bezier surfaces. Bezier surfaces have the same properties as Bezier's curves. The Bezier surfaces provide a convenient method for interactive design application. Two sets of orthogonal Bezier curves can be used to design an object surface by specifying by an input mesh of control points. The parametric vector function for the Bezier surface is formed as the Cartesian product of Bezier blending functions:

$$P(u, v) = \sum_{j=0}^{m} \sum_{k=0}^{n} P_{j,k} BEZ_{j,m}(v) BEZ_{k,n}(u)$$



A composite Bezier surface constructed with two Bezier sections, joined at the indicated boundary line. The dashed lines connect specified control points. First-order continuity is established by making the ratio of length *L, to length L, constant for each collinear* line of control points across the boundary between the surface sections.

3. METHODS FOR GENERATING NON-PLANNER SURFACES:

Polygon surface:

The most commonly used boundary representation for a 3-D graphic object is a set of surface polygon that encloses the object interior. Many graphic systems stored all object description a sets of surface polygon. This simplifies and speed of the surface rendering and display an object scene all the surface describe with linear equation. A polygon representation of a polyhedron precisely defines the surface of an objects.

Polygon Table:

Polygon Table is generally used to represent 3-D object. As information for each polygon is input, which are to be placed in to table that are used for processing, display and manipulation of the in a scene. Polygon data tables can be organized in to two groups:

- Geometric table.
- Attribute Table.

Geometric table:

It contains vertex co-ordinates and parameter to identify the spatial orientation of polygon surface.

Rues for creating Geometric table:

- Every vertex in listed as an end point for at least two edges.
- Every edge is part of at least one polygon
- Each polygon has at least one shared edge.
- Every surface is close.

Attribute table:

Attribute table includes parameters specifying the degree of transparency of the object. It gives attribute information for an object (degree of transparency, surface reflectivity etc). It also includes information about its surface reflectivity and texture characteristics.

Polygon Meshes:

Polygon mesh is a collection of edges, vertices and surfaces. Each edge is shared by at most two polygons. An edge connects two vertices and a polygon is a closed sequence of edge. An edge can be shared by two adjacent polygon and vertices is shared at least two edges. Some graphics packages provide several polygon functions for modeling objects. A single plane surface can be specified with a function like *fillArea* in PHIGS package. High graphics systems typically model objects with polygon meshes and set up a database of geometric and attribute information.

PLANE EQUATION:

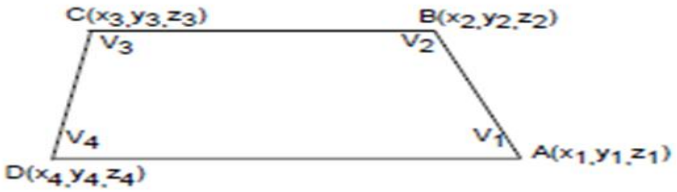
It is used to determine the spatial orientation of the individual surface component of the object.

The equation of the plane is: $Ax+By+Cz+D = 0$

Solution of plane Co-efficient can be done by two methods:

- Algebraic Approach.
- Vertex Approach.

Detailing the plane equation using Algebraic Approach:



If (x_1,y_1,z_1) , (x_2,y_2,z_2) and (x_3,y_3,z_3) are three successive vertex of the plogygon then

$$Ax+By+Cz = -D$$

$$(A/D)x+(B/D)y+(C/D)z = -1$$

$$(A/D)x_1+(B/D)y_1+(C/D)z_1 = -1 \quad \text{.....(i)}$$
$$(A/D)x_2+(B/D)y_2+(C/D)z_2 = -1 \quad \text{.....(ii)}$$
$$(A/D)x_3+(B/D)y_3+(C/D)z_3 = -1 \quad \text{.....(iii)}$$

By cramers rule:

$$A = \begin{vmatrix} 1 & y_1 & z_1 \\ 1 & y_2 & z_2 \\ 1 & y_3 & z_3 \end{vmatrix}$$

$$B = \begin{vmatrix} x_1 & 1 & z_1 \\ x_2 & 1 & z_2 \\ x_3 & 1 & z_3 \end{vmatrix}$$

$$C = \begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$$

$$D = \begin{vmatrix} x_1 & y_1 & z_1 \\ x_2 & y_2 & z_2 \\ x_3 & y_3 & z_3 \end{vmatrix}$$

Expanding the determinant we can write that,

$$A = y_1(z_2-z_3) + y_2(z_3-z_1) + y_3(z_1-z_2)$$

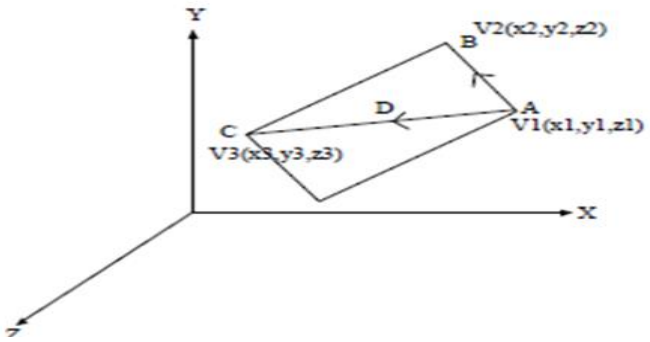
$$B = z_1(x_2-x_3) + z_2(x_3-x_1) + z_3(x_1-x_2)$$

$$C = x_1(y_2-y_3) + x_2(y_3-y_1) + x_3(y_1-y_2)$$

$$D = -x_1(y_2z_3-y_3z_2) - x_2(y_3z_1-y_1z_3)-x_3(y_1z_2-y_2z_1)$$

As vertex values and other information are entered into the polygon data structure, values for A,B,C and D are computed for each polygon and store with other polygon data.

Detailing the plane equation using Vertex Approach or Vector Approach:



The position vector of v_1,v_2, and v_3 are

V_1 = OA = (x_1,y_1,z_1)

V_2 = OB = (x_2,y_2,z_2)

V_3 = OC = (x_3,y_3,z_3)

Taking cross product **AB × AC**

AB = OB – OA

= $(x_2-x_1,\ y_2-y_1,z_2-z_1)$

AC = OC – OA

= $(x_3-x_1,y_3-y_1,z_3-z_1)$

$$\therefore \text{AB} \times \text{AC} = \begin{bmatrix} i & j & k \\ x_2-x_1 & y_2-y_1 & z_2-z_1 \\ x_3-x_1 & y_3-y_1 & z_3-z_1 \end{bmatrix}$$

$$= \mathbf{i}\ \{(z_3-z_1).(y_2-y_1) - (z_2-z_1).(y_3-y_1)\}$$
$$= -\mathbf{j}\ \{(x_2-x_1)(z_3-z_1) - (z_2-z_1)(x_3-x_1)\}$$
$$= \mathbf{k}\ \{(x_2-x_1)(y_3-y_1) - (y_2-y_1)(x_3-x_1)\}$$

$$\text{Component of } \mathbf{i} = \begin{bmatrix} y_2-y_1 & z_2-z_1 \\ y_3-y_1 & z_3-z_1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & y_1 & z_1 \\ 0 & y_2-y_1 & z_2-z_1 \\ 0 & y_3-y_1 & z_3-z_1 \end{bmatrix}$$

$$R_2 \longrightarrow R_1+R_2$$
$$R_3 \longrightarrow R_1+R_3$$

Similarly,

B = Component of **j**

C = component of **k**

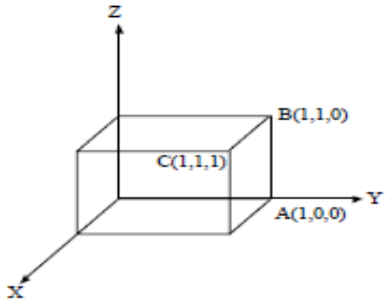
Hence , the plane coefficients (A,B,C) gives normal vector to the plane. Further, if P(x,y,z) be any point on the plane then,

N.P = (A, B, C). (x,y,z)

= Ax+By+Cz

∴ D = -N.P

Example:



$$\vec{N} = \overrightarrow{AB} \times \overrightarrow{AC}$$
$$\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA}$$
$$= (1\text{-}1,1\text{-}0,0\text{-}0)$$
$$= (0,1,0)$$
$$\overrightarrow{AC} = \overrightarrow{OC} - \overrightarrow{OA}$$
$$= (1\text{-}1,1\text{-}0,1\text{-}0)$$
$$= (0,1,1)$$

$$\vec{N} = \overrightarrow{AB} \times \overrightarrow{AC}$$
$$= (0,1,0) \times (0,1,1)$$
$$= \mathbf{j} \times (\mathbf{j}+\mathbf{k})$$
$$= 0+\mathbf{i}$$
$$= \mathbf{i}$$
$$= (1,0,0)$$

Therefore, A = 1, B= 0, C=0

$$\vec{D} = -\vec{N}.\vec{P}$$
$$= -(1,0,0).(1,0,0)$$
$$= -1$$
$$\therefore \vec{D} = 1$$

Therefore the plane equation is: Ax+By+Cz+D = 0 or x-1=0

The plane equation are used ot determine the position of spatial points relative to the plane surface of an object. If p(x,y,z) is any point on the plane then the distance between the point and the plane is:

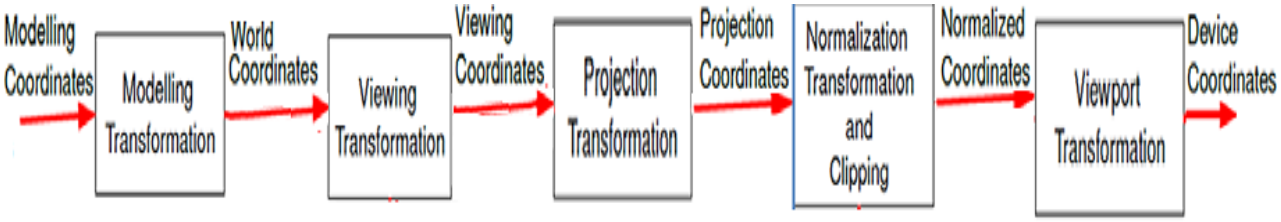
$$\mathbf{d} = \frac{Ax + By + Cz}{\sqrt{A^2 + B^2 + C^2}}$$

If d = 0 , Ax+By+Cz+D = 0 i.e point is on the plane.
If d<0, Ax+By+Cz+D = 0 i.,e point is inside the plane.
If d>0, Ax+By+Cz+D = 0 i.e point is outside the plane.

The side of the plane that faces the object interior is 'inside' face and visible face is 'outside' face. If polygon vertices are specified in counter clockwise direction when viewing the outer side of the plane in right handed coordinate system the direction of normal vector will be from inside to outside.

4. THREE DIMENSIONAL OBJECT TO SCREEN VIEWING TRANSFORMATION:

Viewing processes for a 3D scene are in many ways similar to that of 2D. However, the extra dimension brings with it a host of complexities such as lighting and viewing projections. Coordinates undergo (complete) a series of transformations to produce the final image on the screen. The 3D viewing process is inherently more complex then is the 2D viewing process. In 2D we simply specify the window on 2D world and a viewpoint on the 2D-view surface. Conceptually objects in the world are clipped against the window and are then transformed into the viewpoint for display. The extra complexity 3D-viewing is caused in the part by the added dimensions and in part by the fact that display device are only 2D.



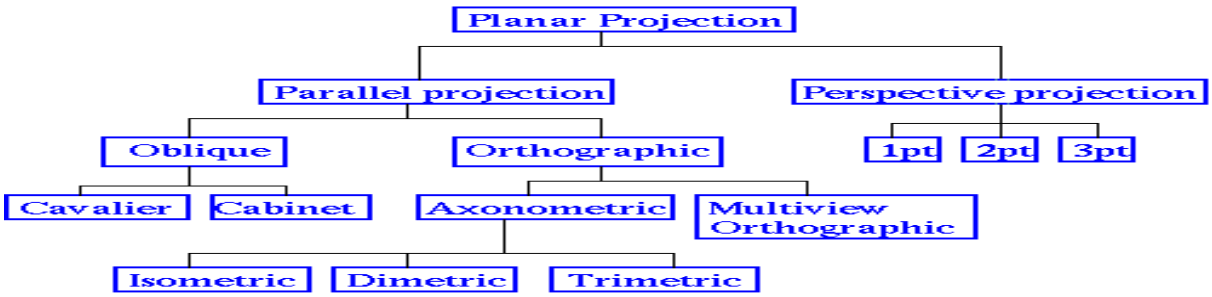
Explanation:

Modelling Transformation and Viewing Transformation can be done by 3D transformations. The viewing-coordinate system is used in graphics packages as a reference for specifying the observer viewing position and the position of the projection plane. Projection operations convert the viewing-coordinate description to coordinate positions on the projection plane. (Involve clipping, visual-surface identification, and surface-rendering) Workstation transformation maps the coordinate positions on the projection plane to the output device.

5. THREE DIMENSIONAL DISPLAY METHODS:

PROJECTION:

Projection is the presentation of an image on a surface, especially a movie screen- quality. Projection is a method that must be use to map the three dimensional model to a two dimensional projection plane. The art of representing a three-dimensional object or scene in a 2D space is called projection. Projections are used for Representing an World Coordinate Object , having three Coordinate System to two Coordinate System . This is used for viewing a Small Portion from a Entire Window. Projections are used for viewing a Portion of a Window. Various types of projections are used to generate multi-views of a model. Which type of projection is used depends on the needs of the user. There are two types of projections which are mentioned below:



1. PARALLEL PROJECTION:

Parallel Projection is that which have a Perpendicular on the Plane. In a parallel projection, parallel lines in the world coordinate scene project into parallel lines on the two-dimensional display plane. It is one method for generating a view of a solid object is to project points on the object surface along with parallel lines onto the display plane. This technique is used in engineering and architectural drawings to represent an object with a set of views that maintain relative proportions of the object. These are linear transforms (implemented with a matrix) that are useful in blueprints, schematic diagrams, etc.

Characteristics of Parallel Projection:

- Centre of projection infinitely far from view plane.
- Projectors will be parallel to each other.
- Need to define the direction of projection (vector).
- 2 sub-types consists:
- Orthographic Projection :- direction of projection is normal to view plane
- Oblique Projection :- direction of projection not normal to view plane
- Better for drafting / CAD applications.

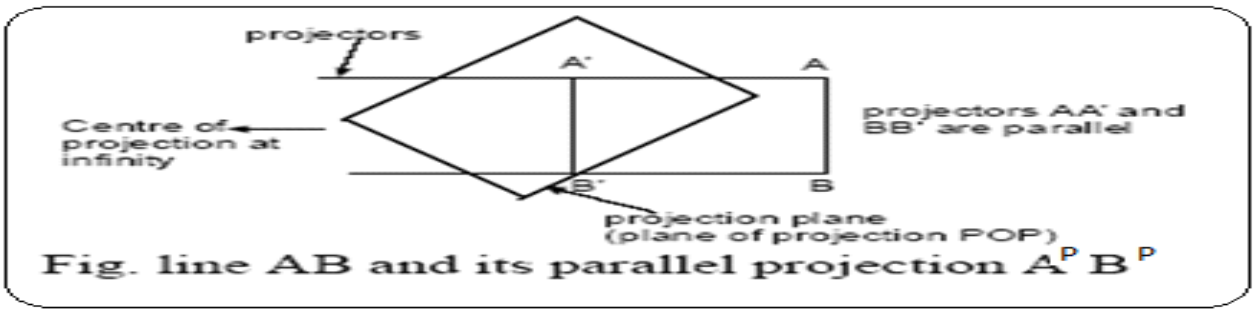


Fig. line AB and its parallel projection $A^P B^P$

If the distance between centre of projection (COP) and plane of projection (POP) is infinite then projection is called parallel projection, i.e the rays from COP are paralleled. So it maintains relative proportion of the object. In this projection we extend parallel lines from each vertex plane of the screen.

Equation of line in 2D is

$$(y-y_1)/(x-x_1) = (y_2-y_1)/(x_2-x_1)$$

In parametric form,

$$x = x_1+(x_2-x_1)u$$
$$y = y_1+(y_2-y_1)u \quad u \varepsilon [0,1]$$

Similarly in 3D,

$$x = x_1+(x_2-x_1)u$$
$$y = y_1+(y_2-y_1)u$$
$$y = z_1+(z_2-z_1)u$$

Let direction of projection is given by vector $[x_p,y_p,z_p]$ and the image is to be projected on the xy-plane. If we have a point on the object at (x_1,y_1,z_1) and the projected point be (x_2,y_2) then the equation of the line is ,

$$x = x_1+x_pu$$
$$y = y_1+y_pu$$
$$z = z_1+z_pu$$

But on the xy plane

$$0 = z_1+z_pu$$
$$\therefore u = -z_1/z_p$$
$$x_2 = x_1-z_1(x_p/z_p)$$
$$y_2 = y_1-z_1(y_p/z_p)$$

i.e
$$\begin{bmatrix} x_2 \\ y_2 \\ z_2 \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & -x_p/z_p & 0 \\ 0 & 1 & -y_p/z_p & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ y_1 \\ z_1 \\ 1 \end{bmatrix}$$

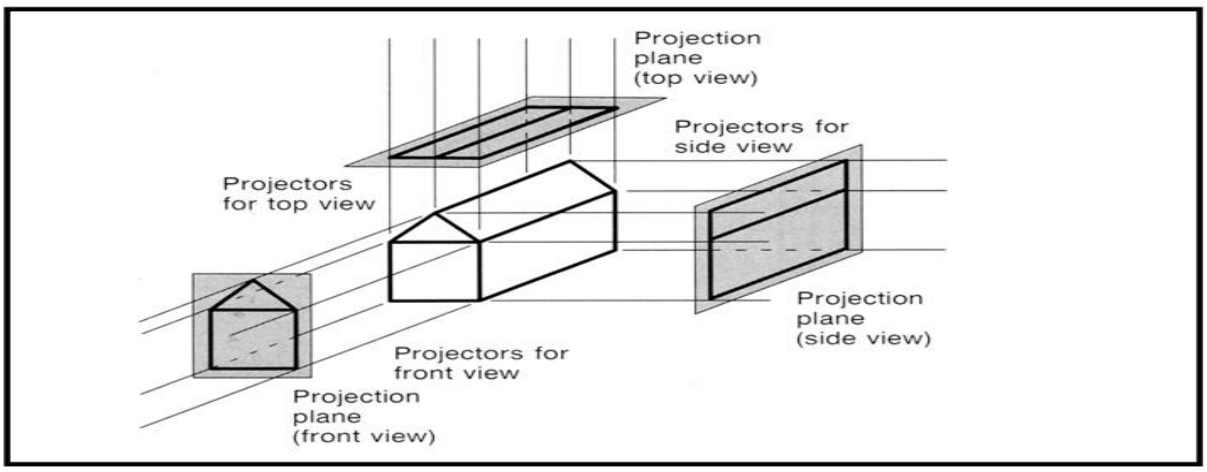
However, while drawing the projected image we just ignore the z plane.

Types of Parallel Projections:

- Orthographic or Orthogonal Parallel Projection
- Oblique Projection

Orthographic parallel projections are done by projecting points along parallel lines that are perpendicular to the projection plane. Most often used to produce the front, side and top views of an object Engineering and architectural drawing commonly employ these orthographic projections.

- Front, side and rear orthographic projections of an object are called **elevations** and the top orthographic projection is called **plan view**.
- all have projection plane perpendicular to a principle axes.
- Here length and angles are accurately depicted and measured from the drawing, so engineering and architectural drawings commonly employee this.
- However, As only one face of an object is shown, it can be hard to create a mental image of the object, even when several views are available.



Oblique projections are obtained by projecting along parallel lines that are NOT perpendicular to the projection plane. It is useful to show the general 3D shape of an object. Two oblique projections are well known: Cavalier and Cabinet.

2. PERSPECTIVE PROJECTION:

Another method for generating a view of a three-dimensional scene is to project Methods points to the display plane along converging paths. If the distance between POP and COP is finite and converges to a single point (Vanishing point) then the projection is called perspective projection. It transforms points of 3D object along projection lines that meet at vanishing point. The size of the object doesn't remains same and varies with the distance of the object from COP. Objects further from viewing position is displayed smaller than objects of same size that are nearer to viewing positions. Perspective projection is more realistic than parallel. These are non-linear transforms. Perspective projections can be implemented with a matrix in projective space followed by a divide by the homogeneous coordinate. This is very useful in architectural rendering, realistic views, etc.

Perspective projection is a method for producing realistic pictures. It is a mathematical system that indicates how a real-world scene would project to a vantage point. If a picture is to be produced, a picture surface is placed between the real-world scene and the vantage point. Each point of interest in the real-world scene is joined to the vantage point by a straight line. A depicting point is placed on the picture surface where the line intersects it. Perspective pictures look realistic because they recreate the pattern of light of the real-world scene.

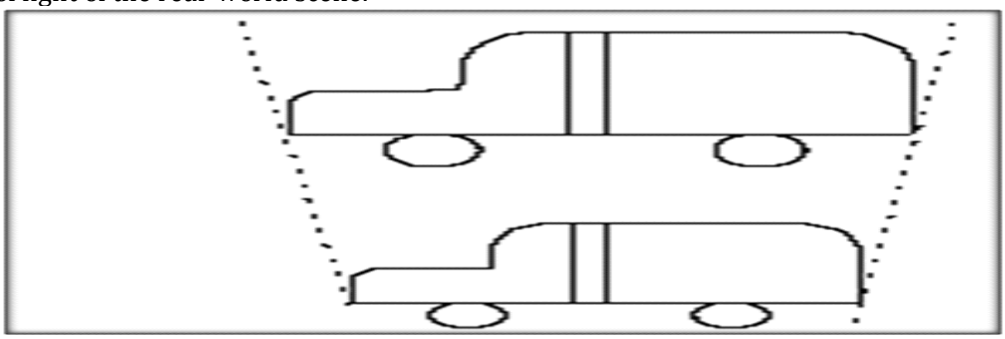
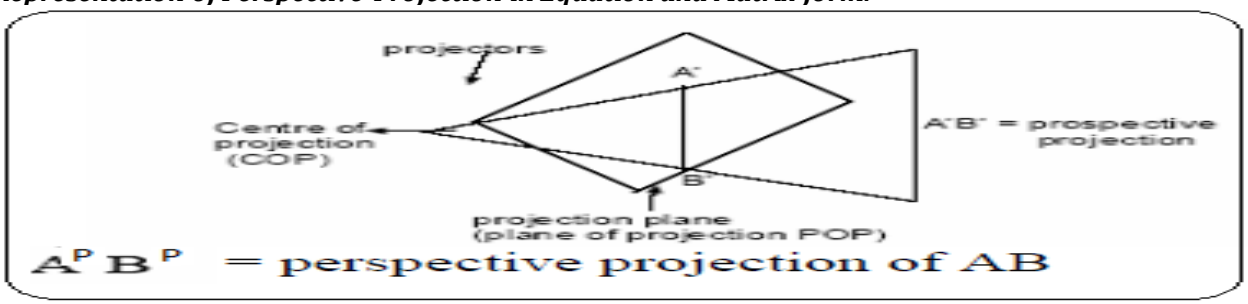


Figure: Same vahicle to show perspective projection

Characteristics of Perspective Projection:

- Centre of projection finitely far from view plane.
- Projectors will not be parallel to each other.
- Need to define the location of the centre of projection (point).
- Classified into 1, 2, or 3-point perspective.
- More visually realistic - has perspective foreshortening (objects further away appear smaller).
- Difficult to Execute.
- Difficult to Determine Exact size and shape of the object.

Representation of Perspective Projection in Equation and Matrix form:



If the COP at [x_c, y_c, z_c] and the point on the object is [x,y,z] then projection ray will be the line joining these points. Equation of the line is

$x = x_c+(x_1-x_c)u$

$y = y_c+(y_1-y_c)u$

$z = z_c+(z_1-y_c)u$

The projected point on xy plane i.e (x_2,y_2) will be the point where the line intersects the xy plane.

i.e $z_c = 0$, $z_c+(z_1-z_c)u = 0$

i.e $u = -z_c/(z_1-z_c)$

$x_2 = (x_cz_1-x_1z_c)/(z_1-z_c)$

$y_2 = (y_cz_1 - y_1z_c)/(z_1-z_c)$

$[x_2,y_2,z_2] = [(x_cz_1-x_1z_c)/(z_1-z_c), (y_cz_1 - y_1z_c)/(z_1 - z_c), 0]$

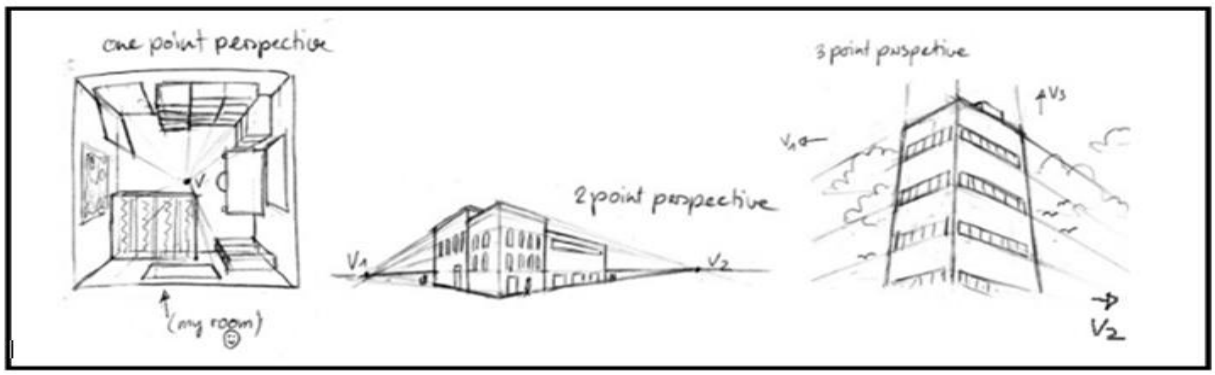
In homogenous form (Homogenous co-ordinate system)

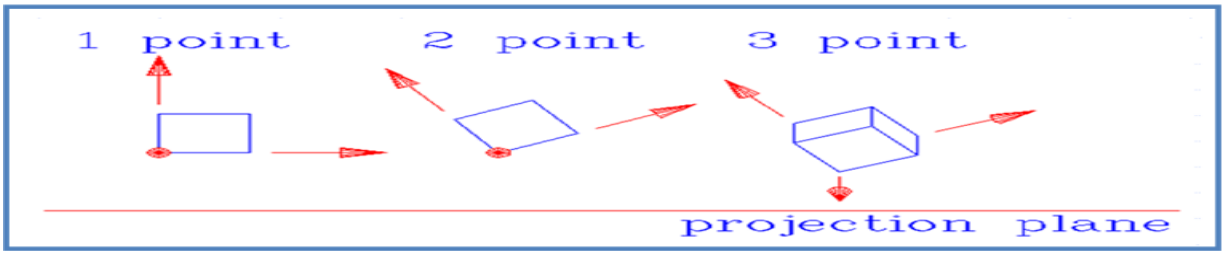
$[x_2,y_2,z_2,1] = [x_cz_1-x_1z_c, y_cz_1-y_1z_c, 0, z_1-z_c]$

$$\begin{bmatrix} x_2 \\ y_2 \\ z_2 \\ 1 \end{bmatrix} = \begin{bmatrix} -z_c & 0 & x_c & 0 \\ 0 & -z_c & y_c & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & -z_c \end{bmatrix} \begin{bmatrix} x_1 \\ y_1 \\ z_1 \\ 1 \end{bmatrix}$$

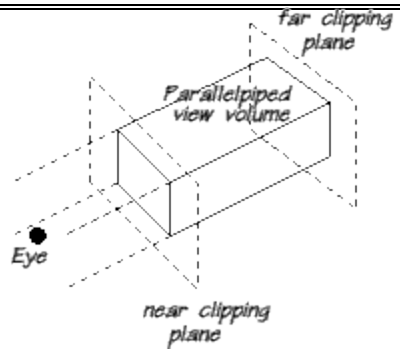
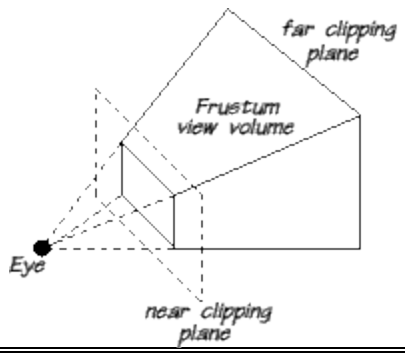
Types of Perspective Projections:

1. One-Point Perspective
2. Two-Point Perspective
3. Three-Point Perspective





DIFFERENCE BETWEEM PARALLEL PROJECTION AND PERSPECTIVE PROJECTION:

S.N.	Parallel projection	Perspective projection
1.	The center of projection is at infinite distance from the projection plane.	The center of projection is at a finite distance from the projection plane.
2.	Projections are parallel.	The lines of projections are converges to a point i.e. lines of projection appears to meet at point on the view plane(Vanishing point)
3.	To define parallel projection, we specify the direction of projection.	To define perspective projection ,we explicitly specify centre of projection.
4.	It is used by drafters and organisers to create working drawing at an object which preserves its scale and shape.	The visual effect is similar to that of photographic systems.
5.	The scale and shape is of an object is preserved there can be different constant foreshortening along each axis.	The size of the projection of an object varies inversely with the distance of that object from the center of projection.
6.	Parallel projection is useful for exact measurement and shape of the objects.	Perspective projection is not useful for recording the exact shape and measurement of the objects.
7.		

6. VISIBLE SURFACE DETECTION METHODS:

The methods that are used for identifying those of a scene that are visible from a chosen viewing position are referred to as visible surface detection methods. Sometimes these methods are also known as hidden surface elimination method. Sometimes these methods are referred to as hidden surface removal methods. A major consideration in the generation of realistic graphics displays is identifying those parts of a scene that are visible from a chosen viewing position. The various algorithms are referred to as visible-surface detection methods.

Some methods require more memory, some involve more processing time, and some apply only to special types of objects. These methods support to produce realistic scenes where closer objects occlude the others. Determination of which algorithm to be applied for a particular application involves the various conditions: complexity of the scene, type of the object to be displayed, available equipment, type of display needed i.e. static or animated etc.

In 3D Computer graphics, it is the process in which we decide which surface or part of surface are not visible from a certain viewpoint. It's solution is a hidden surface algorithm that is visibility problem. It was the first major problem in the field of 3D computer graphics. This process of hidden surface is called hiding and algorithm which is used called a hider.

Firstly an image is scanned correctly, which part of the image is not visible that should not be drawn. It also speeds up rendering since objects that are not visible can be removed from the graphics pipeline.

Through many techniques we can determination hidden surface. There are different stages of hidden surfaces determination.

These stages include:-

1. Back face Culling
2. Viewing Frustum Culling

3. Occlusion Culling
4. Contribution Culling.

Visible surface detection algorithms are broadly classified according to whether they deal with object definitions directly or with their projected images. These two approaches are mentioned below as:

1. Object space Method
2. Image Space Method

An **object space method** compares objects and parts of objects to each other within scene definition to determine which surfaces are visible. Line display algorithm generally use object space method to identify visible lines in wire-frame display. This method is used to determine the parts of the shapes are to be rendered in 3D coordinates. This method is based on comparison of objects for their 3D positions and dimensions with respect to a viewing position. This method is efficient for small number of objects but difficult to implement it. This method is also referred as the painter's algorithm which is used to draw visible surfaces from back (farthest) to front (nearest) by applying back-face culling, depth sort, BSP tree. Some algorithm consists by this method like Depth Sorting algorithm, Area sub-division methods, Back Face detection method etc.

An **image space method** visibility is decided point by point at each pixel position on the projection plane. Most visible surface algorithms use image-space method although object space method can be used effectively to locate visible surfaces in some cases. This method is based on the pixels to be drawn on 2 Dimension. So, Image space algorithms are also called point sampling. These are also referred as the Image precision algorithms. They perform visibility determination over discrete areas giving results. Space complexity is compares two times the number of pixels one array of pixels for frame buffer and one array of pixels for the depth buffer. In this method coherence properties of surfaces can be used. Some algorithm consists by this method like Depth buffer method, A-Buffer methods, Scan-line method and ray casting methods etc.

Classification diagram of visible surface detection methods:

- Image space methods
  - Z buffer
  - A buffer
  - Scan line
- Object space
  - Back face detection
- Both
  - Depth sorting, Area sub division

Some of the important visible surface detection methods:

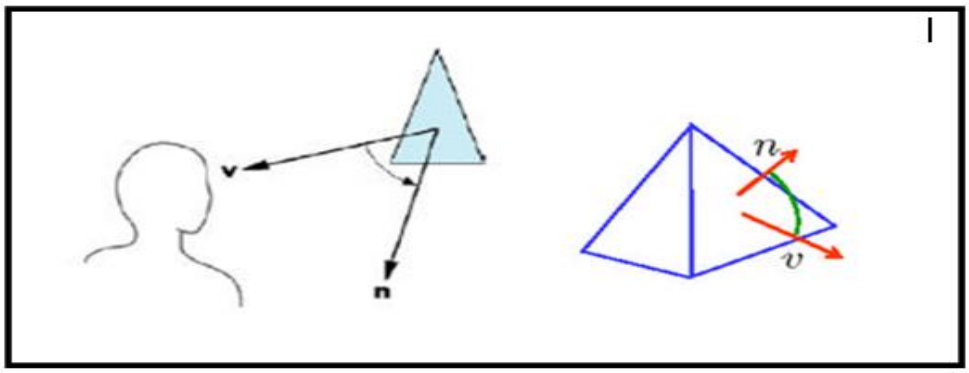
1. **Back Face Detection Method**
2. **Depth Buffer Method or Z-Buffer Method**
3. **A-Buffer Method**
4. **Scan-Line Method**

Back Face Detection Method

It is object space method of visible surface detection. It is a fast and simple object space method for identifying the back-faces of a polyhedron is based on the "inside-outside" tests. In this method the polygon has only two faces i.e. back face and front face. Note that this technique only caters well for non-overlapping convex polyhedral. This method is use to remove unseen polygons from convex, closed polyhedron. This method is not suitable for overlapping surface consisting objects i.e. does not completely solve hidden surface problem since one polyhedron may obscure another.

Some terms related to Back Face Detection Methods:

1. It is also called back face culling where we see a polygon if it's normal is pointed toward the viewer:



2. A point (x, y, z) is inside a polygon surface with plane parameters A, B, C & D if
$Ax + By + Cz + D < 0$ **i.e it is in back face**
3. A point (x, y, z) is outside a polygon surface with plane parameters A, B, C & D if
$Ax + By + Cz + D > 0$ **i.e it is in front face**

4. Let '**N**' be the normal vector to a polygon surface, which has Cartesian coordinates (A,B,C) and '**V**' is the vector in the viewing direction, then the polygon in the back face if

$$V \cdot N > 0$$

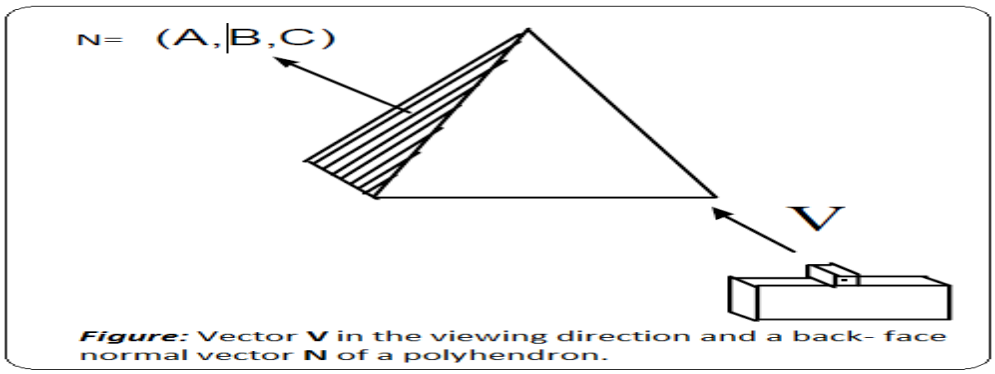


Figure: Vector **V** in the viewing direction and a back- face normal vector **N** of a polyhendron.

- V is a vector in the viewing direction from the eye(camera)
- N is the normal vector to a polygon surface

5. Furthermore , if object description have been converted to projection co-ordinate and our viewing direction is parallel to the viewing zv axis then,
$V = (0,0,v_z)$ and $V.N = v_z C$
6. So that we only need to consider the sign of C (i.e **z**-component of the normal vector N).
7. In a right handed viewing system with viewing direction along the negative **zv**-axis , the polygon is back face if **C<** 0 and also if **C = 0** .

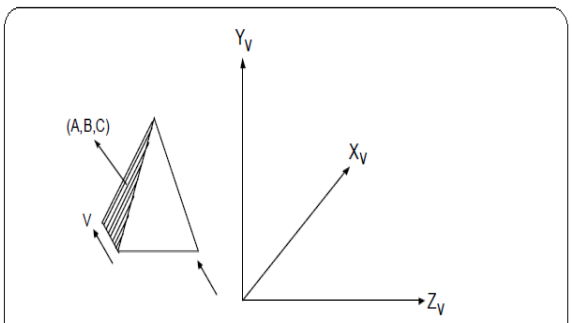


Figure: A polygon surface with plane parameter C<0 in a right-handed co-ordinate system is identified as a back-face when the viewing direction is along the –ve v_z axis.

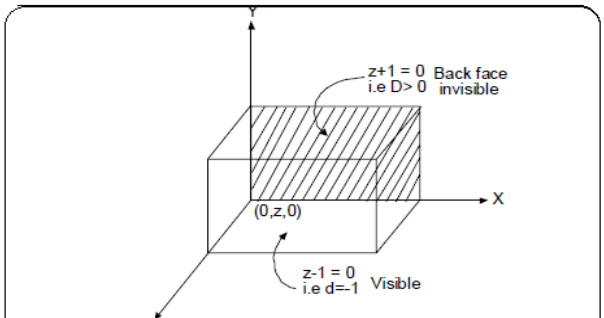


Figure: Viewing condition to the back visible or invisible

8. Thus, in general, we can label any polygon as back face if its normal vector has z-component value.
9. Object is cantered at origin if D > 0 (back face) else front face.

- **Advantage:**
  - A fast and simple object space method for identify the back face of a polyhedron.
  - It is best method for scenes that contain few polygons.
- **Disadvantage:**

- This technique only caters well for non-overlapping convex polyhedra.

Depth Buffer Method:

This Depth Buffer Method is image space method for visible surface detection which is developed Catmull. This method is also known as *z*-buffer method because object depth is usually from the view plane along the Z- axis.. It is a commonly used image-space approach for detecting visible surface is the depth buffer method which compares surface depth at each pixel position on the projection plane. Object depth is usually measured from plane along the z-axis of a viewing system. In this method each surface is processed separately one pixel position at a time across the surface. In this approach the depth values for a pixel are also compared and the closest (smallest z) surface determines the color to be displayed in the frame buffer. This approach is applied very efficiently on polygon surfaces. Surfaces are processed in any order. This method is usually applied to scenes containing only polygon surface because depth values can be computed very quickly and the method is easy to implement.

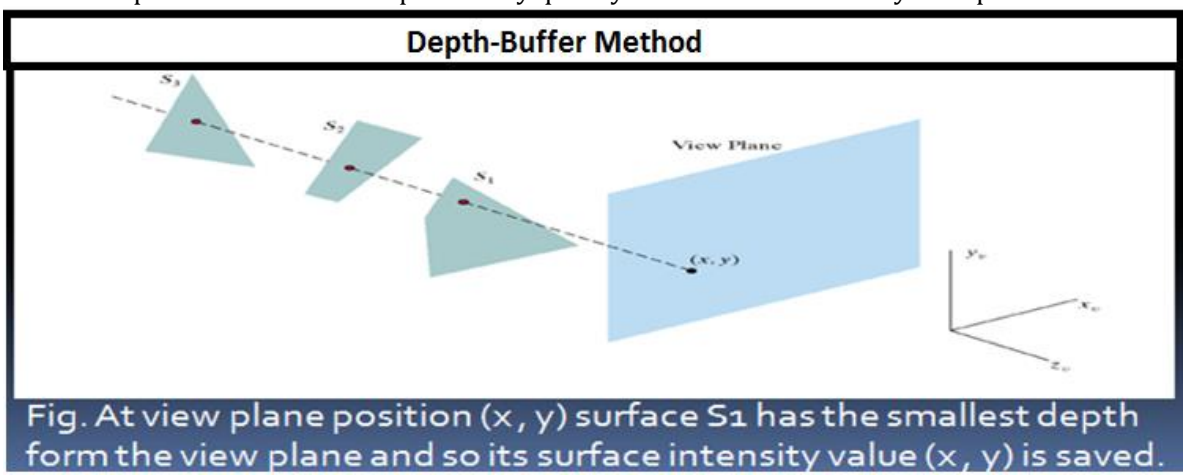


Fig. At view plane position (x, y) surface S1 has the smallest depth form the view plane and so its surface intensity value (x, y) is saved.

Z-Buffer has memory corresponding to each pixel location. Usually it has 16 to 20 bits/location. In this method two buffers are used to store the intensity values and depth values. One of them is **Frame Buffer or Refresh Buffer** which is used to store intensity value at each **(x, y)** position. And another is **Depth Buffer** which is used to store depth values for each **(x , y)** position as surfaces are proceeded
We can implement the depth- buffer algorithm in normalized coordinates. So that **z** values range from 0 at the back clipping plane to $\mathbf{z_{max}}$ at the front clipping plane.

Depth buffer Algorithm:

1. Initialize the depth buffer and refresh buffer as depth (x,y) $=z_{min}$ or 0
2. For each pixel on each polygon surface compare depth value (z-value) to previously stored value in depth buffer (x,y).
   If z > depth (x,y) then set
   Depth(x,y) = z , refresh(x,y) = I_{suface}(x,y)
3. Plot the point(x,y) and z-value at each depth buffer with corresponding values in refresh buffer.

Ways of calculating Z-Buffer:

- **Initialize**
  - **Each z-buffer location ⇐ Max z value**
  - **Each frame buffer location ⇐ background color**
- **For each polygon:**
  - **Compute z(x,y), polygon depth at the pixel (x,y)**
  - **If z(x,y) < z-buffer value at pixel (x,y), then**
    - **z buffer(x,y) ⇐ z(x,y)**
    - **pixel(x,y) ⇐ color of polygon at (x,y)**
- **Depth Calculation:**

- Calculate the z-value on the plane

$$Ax + By + Cz + D = 0 \quad \Rightarrow \quad z = \frac{-Ax - By - D}{C}$$

- Incremental calculation

$z_{(x,y)}$: the depth of position (x, y)

$$z_{(x+1,y)} = \frac{-A(x+1) - By - D}{C} = z_{(x,y)} - \frac{A}{C}$$

$$z_{(x,y-1)} = \frac{-Ax - B(y-1) - D}{C} = z_{(x,y)} + \frac{B}{C}$$

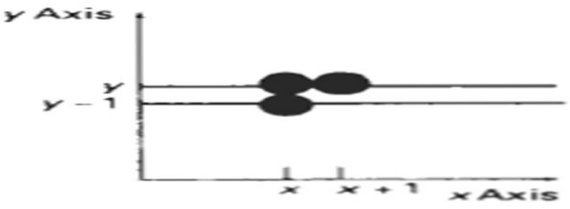


Figure From position (x, y) on a scan line, the next position across the line has coordinates $(x + 1, y)$, and the position immediately below on the next line has coordinates $(x, y - 1)$.

For horizontal movement

$$z' = \frac{-Ax - A - By - D}{C}$$

$$= \frac{-Ax - By - D}{C} - \frac{A}{C}$$

$$= z - A / C$$

For vertical movement

$$z' = \frac{-Ax - B(y-1) - D}{C}$$

$$= \frac{-Ax - By + B - D}{C}$$

$$= \frac{-Ax - By - D}{C} + \frac{B}{C}$$

$$= z + B / C$$

- **Advantages:**
  - No pre-sorting and object-object comparisons are required.
  - Time taken by visible surface calculation is constant.
  - It is simple and easy implementation in hardware and software.
  - If memory is at permission scan converted in strips.
  - Process polygons in arbitrary order.
  - Handles polygon interpenetration trivially.
  - Good for animation.
- **Disadvantage:**
  - Requires amount of memory for z and frame buffer.
  - It is subject to aliasing.
  - It is consists integer depth values.
  - Super-sampling
  - Overhead in z-checking: requires fast memory

A-Buffer Method:

The A- Buffer Method is an extension of Z-Buffer Method. The A- Buffer Method is visibility detection method that developed at Lucas film Studios for the rendering system REYES (Renders Everything You Ever Saw). The A- Buffer Method expands on the depth buffer method to allow transparencies. The A-Buffer Method represents an antialiased, area-averaged, accumulation –buffer method. The A-buffer

expands on the depth buffer method to allow transparencies. The key data structure in the A-buffer is the accumulation buffer. A drawback of depth buffer (i.e. Z-Buffer method) is that it can find one visible surface at each pixel position but in A- Buffer Method each position in the buffer can reference a linked list of surfaces. More than one surface intensity can be taken into consideration at each pixel position, and object edges can be antialiased.

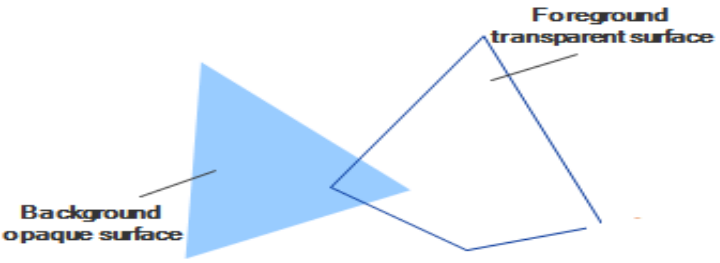


Figure: Viewing an opaque surface through a transparent surface requires multiple surface-intensity contributions for pixel position.

Each position in the A-Buffer has two fields that are **Depth Field** which stores a positive or negative real number and another **Intensity Field** which stores surface-intensity information or a pointer value.

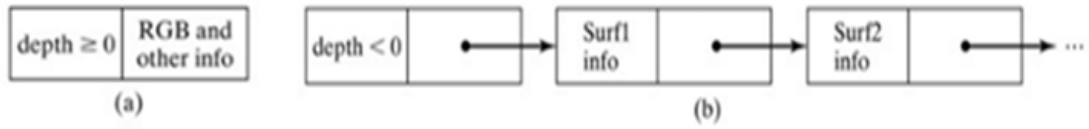


Figure to show organisation of an A-Buffer pixel position where:
(a) Single-surface overlap of the corresponding pixel area and **(b)** Multiple-surface overlap.

- If depth is >= 0, then the surface data field stores the depth of that pixel position as before. (Single intensity & single depth value).
- If depth < 0 then the data filed stores a pointer to a linked list of surface data.(multiple surfaces).
- If the depth value is positive, the number stored at that position is the depth of a single surface overlapping the corresponding pixel area.
- The intensity field stores the RGB components of the surface color at that point and the percent of pixel coverage.
- If the depth value is negative, this indicates multiple – surface contributions to the pixel intensity.
- The intensity field then stores a pointer to a linked list of surface data.
- Data for each surface in the linked list includes the following details.
  - RGB intensity components
  - Opacity parameter
  - Depth
  - Percent of area coverage
  - Surface identifier
  - Other surface rendering parameters

The algorithm proceeds just like the depth buffer algorithm. The depth and opacity values are used to determine the final colour of a pixel.

- **ADVANTAGES:**
  - An extension of the ideas in the depth-buffer method.
  - Antialiased, area-averaged, accumulation-buffer.
  - In this Method each position in the buffer can reference a linked list of surfaces.
  - Widely used for high quality rendering.
- **DISADVANTAGE:**
  - More memory intensive.

Scan-Line Method:

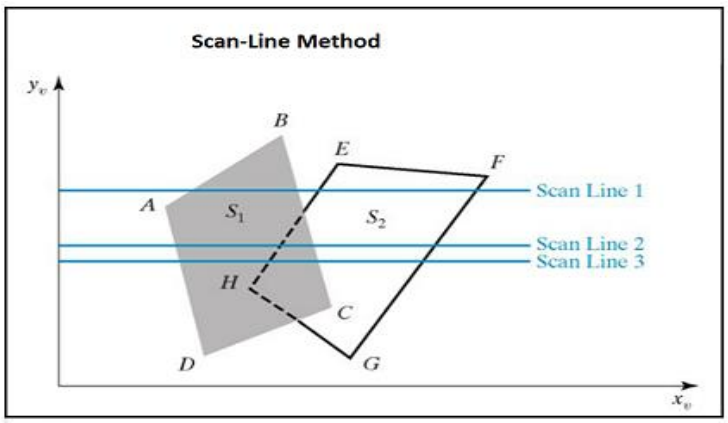
It is an image space method for identifying visible surfaces. Computes and compares depth values along the various scan-lines for a scene. An extension of the scan-line algorithm widely used for filling polygon interiors. As the scan line is processed, all polygon surfaces intersecting the line are examined to determine which are visible. Across each scan line, depth calculations are made for overlapping surface

to determine nearest view plane. After determining visible surface intensity value that position is entered in refresh buffer.

All informations about surfaces are maintained in the **edge table** and polygon **table** or **surface face table** which listed below:

- **The edge table contains:**
  - Coordinate end points of each line in the scene
  - The inverse slope of each line
  - Pointers into the polygon table to connect edges to surfaces
- **The polygon tables or surface face table contains:**
  - The plane coefficients
  - Surface material properties
  - Other surface data
  - Maybe pointers into the edge table

To facilitate the search for surfaces crossing a given scan-line an active list of edges is formed for each scan-line as it is processed. The active list stores only those edges that cross the scan-line in order of increasing **x**. Also a flag is set for each surface to indicate whether a position along a scan-line is either inside or outside the surface. Pixel positions across each scan-line are processed from left to right. At the left intersection with a surface the surface flag is turned on. At the right intersection point the flag is turned off. We only need to perform depth calculations when more than one surface has its flag turned on at a certain scan-line position.



Edge Pairs		S1	S2	
AB	BC	ON	OFF	
EH	FG	OFF	ON	
AD	EH	ON	OFF	
EH	BC	ON	ON	
BC	FG	OFF	ON	

Figure: (a) ***Scan lines crossing the projection of tow surfaces, s1 and s2 in the view plane. Dashed line indicates the boundaries of hidden surfaces and*** **(b)** ***locating the visible portions of the surfaces for pixel positions along the lines.***

- If two surfaces are set to ON then we have to calculate the surface depth.
- Store the surface information of the surface having minimum depth.
- In the above example, S1 has minimum depth. Therefore store the surface information to the refresh buffer.

Some facts related to the Scan line method are listed below:

- The scan line method solves the hidden surface problem one scan line at a time.
- Processing of the scan line start from the top to the bottom of the display.
- This method calculates the z-value for only the overlapping surface which is tested by scan line.
- It request edge table, polygon table/surface table active edge list and flag.

ADVANTAGES:

- Any number of overlapping polygon surfaces can be processed with this scan line method.
- Flags for the surfaces are set to indicate whether a position is inside or outside.
- Depth calculations are performed when surfaces overlap.

DISADVANTAGE:

- The scan-line method runs into trouble when surfaces cut through each other or otherwise cyclically overlap.

UNIT: 6 ILLUMINATION AND RENDERING

1. LIGHT SOURCES:

Light from source such as light bulb, the Sun treated by considering each point on surface. Light source is that object that is emitting radiant energy.When we view an opaque non-luminous object, we see reflected light from the surface of the object. The total reflected light is the sum of the contribution from the light source. Thus, a surface that is not directly exposed to a light source may still be visible if nearby objects are illuminated. Sometimes, light sources are referred to as light-emitting sources. Reflecting surfaces, such as the walls of a room, are termed light-reflecting sources.

Types of light source:

- Point light source : Eg. The Sun
- Distributed (Area) light source: Eg. Fluorescent light

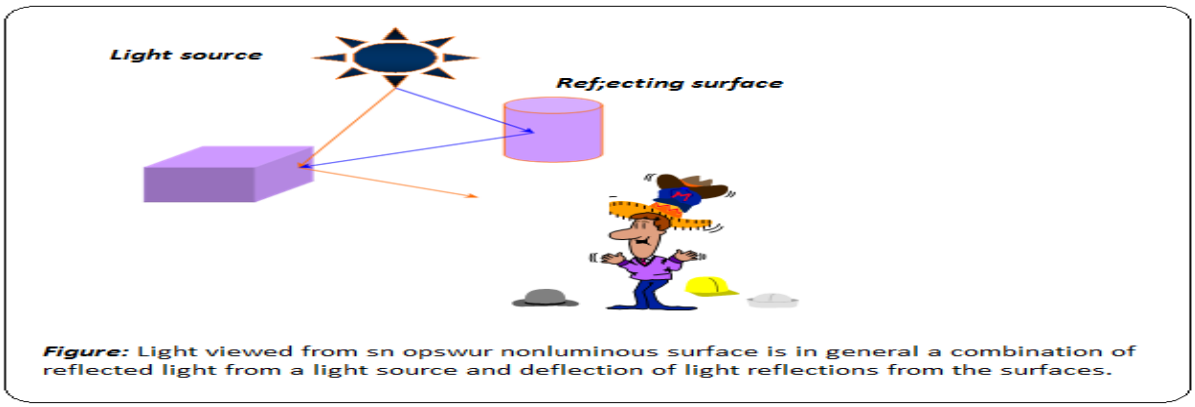


Figure: Light viewed from sn opswur nonluminous surface is in general a combination of reflected light from a light source and deflection of light reflections from the surfaces.

2. Illumination models:

When light is incident on an opaque surface, part of it is reflected and part is absorbed. The amount of incident light reflected by a surface depends on the type of material. Shiny materials reflect more of the incident light, and dull surfaces absorb more of the incident light. Similarly, for an illuminated transparent surface, some of the incident light will be reflected and some will be transmitted through the material.

Types of reflection:

- Diffused reflection
- Specular reflection

Diffused reflection: Diffuse reflection is constant over each surface in a scene independent of viewing direction. If surface is exposed to a point source we assume diffuse reflections from this surface are scattered with equal intensity in all directions. Such surfaces are also called ideal diffuse reflectors. Rough of grainy surface cause diffused reflection. Surface appear equally bright from all viewing direction.

- Rough of grainy surface cause diffused reflection
- Surface appear equally bright from all viewing direction

Specular Reflection: The last component of the commonly-used local illumination model is one that takes into account specular reflections. In shiny surface we see high light or bright spot from certain viewing directions called specular reflection. The specular reflection will cause a white highlight in the direction of the viewer.

- Light reaching the object is reflected in the direction having the same angle
- Creates bright spots or highlights due to shiny reflector surfaces.

Ambient light:

Surface that is not exposed directly to a light source still will be visible if nearby objects are illuminated. This light is called ambient light. In our basic illumination model, we can set a general level of brightness for a scene. This is a simple way to model the combination of light reflections from various surfaces to produce a uniform illumination called the **ambient light, or background light**. Ambient light has no spatial or directional characteristics. The amount of ambient light incident on each object is a constant for all surfaces and over all directions.

Characteristic of Ambient light:

- It provides general level of brightness for all surfaces.
- It has no spatial or directional characteristics.
- It has same intensity for each surface regardless of viewing direction.

3. POLYGON RENDERING METHODS:

POLYGON RENDERING:

Polygon rendering means giving proper intensity at each point in a graphical object to make it look like real world object. A Surface rendering method is also called a lighting model or an illuminating model. Sometimes it is referred to as a shading model or ***surface-shading methods.*** It is used to calculate the intensity of light. The realism of a raster scan image of a 3D scene depends upon the successful stimulation of shading effects. Once visible surface has been identified by hidden surface algorithm, a shading model is used to compute the intensities and color to display for the surface. A surface-rendering algorithm uses the intensity calculations from an illumination model to determine the light intensity for all projected pixel positions for the various surfaces in a scene.

Some Terms Related to rendering the object:

- **Shading :** Simulation the effects of light shining on a surface.
- **Intensity :** that we see on a surface is dependent upon:
  - The type of light sources.
  - The surface characteristics (E.g. Shining, matte, dull, and opaque or transparent).

Different Types of Rendering Methods :

- Constant Intensity Shading
- Gouraud Shading. (Intensity interpolation)
- Phong Shading. (Normal Vector Interpolation)
- Fast Phong Shading

Constant Intensity Shading:

Constant Intensity shading is the one of the methods of Polygon rendering. It is also called Flat Shading. It is developed by Bouknight and Wylie et al. in Third Generation. It is the faster and simple method for surface shading. In this method a single intensity is calculated for each polygon (in the polygon-mesh).All points in the surface of polygon are displayed with the same intensity value. Flat shading is widely used in games consoles but it is not more used where realism is required. It is often used for produce Saturn games and texture mapping etc.

For getting good results through Constant Intensity Shading all of the following assumptions are valid:

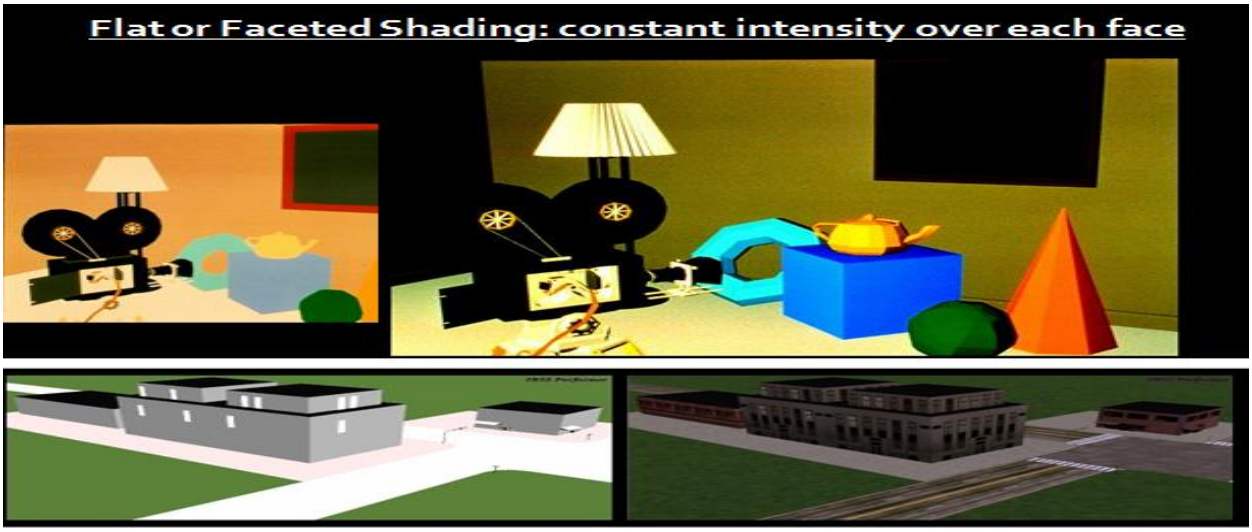
1. Object is a polyhedron.
2. Light sources illuminating the object are sufficiently far from the surface
3. The viewing position is sufficiently far from the surface.

Advantages:

- It is the faster and simple method.
- In this method a single intensity is calculated for each polygon.
- It is widely used in least realistic games consoles.
- No need of extra memory space.

Disadvantages:

- The intensity discontinuity occurs at the border of the two surfaces.
- No –interpolation.
- It is not used for smooth and realism object production.



(Fig 1: an example of texture mapping: the left hand image is flat shaded whilst the right has been textured)

Gouraud Shading :

It is the Intensity interpolation scheme which is developed by Gouraud in 1971. Gouraud shading is also called "intensity interpolation shading" or "color interpolation shading". This method represents a polygon surface by linearly interpolating intensity across the polygon surface. In this method Intensity values for each polygon are matched with adjacent polygon along common edges. Gouraud shading method eliminates the intensity discontinuity that can occur in flat shading. Gouraud shading makes for good realistic scenes with used in combination with texture mapping. It is used to produce better quality object than Flat shading. Gouraud shading is also used in better quality games consoles. The interpolation of color values can cause bright or dark intensity streaks, called the Mach-bands, to appear on the surface. This method is cheaper method of shading, but less accurate (spreads highlights).

Polygon surface is represented by the following calculations:

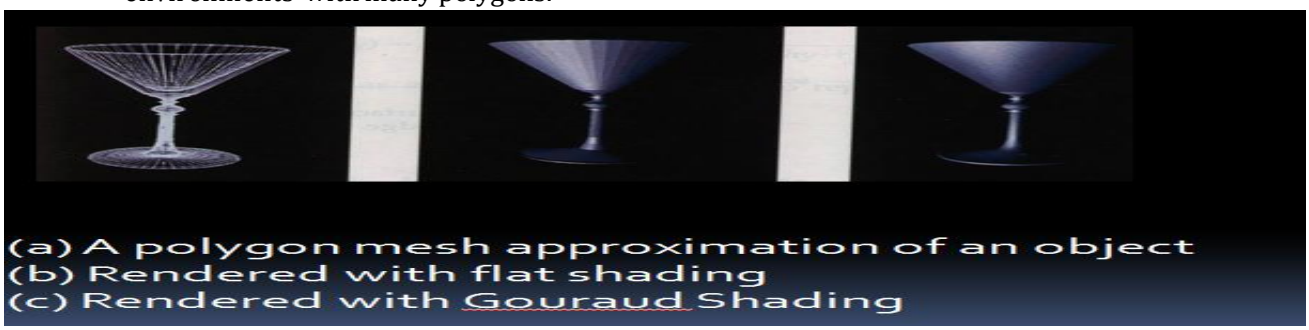
1. Determine the average unit vector at each polygon vertex.
2. Apply an illumination model to each vertex to calculate the vertex intensity.
3. Linearly interpolate the vertex intensities over the surface of the polygon.

Advantages:

- It removes intensity discontinuities associated with flat shading.
- Interpolate color across triangles
- Fast, supported by most of the graphics accelerator cards.

Disadvantages:

- Highlights on the surface are sometimes displayed in irregular shapes.
- Linear intensity interpolation can cause intensity stripe called **Mach bands**, to appear on the surface.
- Gouraud shading is more CPU intensive and can become a problem when rendering real time environments with many polygons.



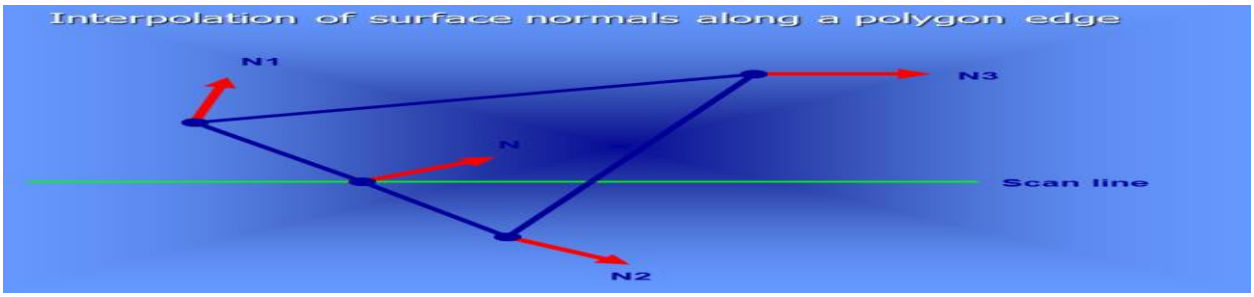
Phong Shading:

Phong Shading is the one of the part of smooth shading. Phong shading is the one of the method of polygon rendering which is developed by Phong Bui Tuong in 1975. Smooth shading of a polygon displays the points in a polygon with smoothly-changing colors across the surface of the polygon. This shading method is more accurate but expensive method than Flat shading and Gouraud shading. This method greatly reduces the Mach-band problem but it requires more computational time. In this shading method the specular highlights are computed much more precisely than in the Gouraud shading model. It is Normal Vector Interpolation

Shading method. This method is used to interpolate normal vectors (i.e. across triangles) and then apply illumination. It overcomes some of the disadvantages of Gouraud shading.

In Phong Shading Method Polygon surface is rendered using the following steps :

- Determine the average unit normal vector at each polygon vertex.
- Linearly interpolate the vertex normals over the surface of the polygon.
- Apply an illumination model along each scan line to calculate projected pixel intensities for the surface points.



- **Advantages Of Phong Shading Model:**
- Intensity calculations produce more accurate results
- Displays more realistic highlights on the surface
- Greatly reduces the Mach-band effect.
- **Disadvantages Of Phong Shading Model:**
- Requires more calculations
- Expensive than other models.
- Not widely supported by hardware.

Fast Phong Shading:

It is faster and easier way to approximate the intensity calculation. Limitations in the normal Phong Shading lead to the development of Fast Phong Shading technique. In this method rendering is faster than the normal Phong shading. In this method surface rendering can be speeded up by using approximations in the illumination-model calculations of normal vectors. It approximates the intensity calculations using a Taylor-series expansion and triangular surface patches. It is the advance technique which used Phong shading way to calculate in advanced and approximated format. Fast Phong Shading is extended method of Phong Shading which can be implemented in hardware for real-time applications or in software to speed image generation for almost any system. It is the expensive technique than other techniques for illuminating the object like real world object.

Comparison between various shading methods:

Constant Intensity Shading vs Gouraud Shading:

Sr.	Constant Intensity Shading	Gouraud Shading
1.	It is also called flat shading.	It is also called Intensity Interpolation shading or color interpolation shading.
2.	The intensity discontinuity occurs at the border of the two surfaces.	Gouraud Shading eliminates intensity discontinuities.
3.	It is not used for smooth and realism object production.	It is used for smooth and realism object production.
4.	It is faster method for shading object.	Gouraud shading is more CPU intensive method.

Phong Shading vs Gouraud Shading:

Sr.	Phong shading	Gouraud Shading
1.	The specular highlights are computed much more precisely than in the Gouraud shading model.	Still not model the specular reflection correctly.
2.	Expensive, but more accurate model.	Cheaper, but less accurate (spreads highlights).
3.	This method greatly reduces the Mach-band problem but it requires more computational time.	The interpolation of color values can cause bright or dark intensity streaks, called the Mach-bands, to appear on the surface.
4.	Phong shading is more expensive than Gouraud shading	Gouraud shading is cheaper than Phong shading.

4. INTRODUCTION TO GRAPHICAL LANGUAGES:

Graphical language or graphical softwares allow people to interact with graphical representation on graphical devices. These allow either individuals or groups of people act collaboratively and perform complex graphical modelling in many endeavours, including engineering, manufacturing, chemistry, bio-chemistry, finance, avionics, mining and logistics. Anything that is controlled, performed, monitored through a display device which involves the graphical language. These programs are used to create images as well as processing the images to make it realistic. Graphical software contains various functions or commands or subroutines that provide an interface between user and the system.

Classification of graphics software:

There are two types of Graphical software used which mentioned as following:

- Special Purpose Application Package
- General Programming Package

Special Purpose Application Package:

The special purpose application packages are programs that are specially designed for non-programmers so that the users can generate displays without worrying about how graphic operation works. These programs are simpler graphical user interface based systems that can be handled by the general user easily. In these types of programs user no need to remember any functions and syntax about the specific software. Application graphics software include CAD packages, Drawing and painting programs (such as Paintbrush), Graphing packages and visualization Programs.

General Programming Package:

A General purpose programming package provides set of graphics functions that can be used in a high level programming language such C,C++ etc. These packages are specially designed for programmers. These types of packages include functions for generating picture components such as lines, circles, polygons etc and other figures, setting of colors and applying transformations. These types of programming packages provide a variety of various operations for creating and manipulating objects or pictures. An example of general graphics programming package is the GL (Graphics Library) system on Silicon Graphics equipment. Examples: PHIGS, PHIGS+, GKS, 3D GKS,GL.

A general programming package provides users with a variety of functions for creating and manipulating pictures. These subroutines can be categorized according to whether they deal with input, output, attributes, transformations, viewing, or general control. Normally graphics package require coordinate specifications to be given with respect to Cartesian reference frames. Each object for a scene can be defined in a separate modelling Cartesian coordinate system, which is than mapped to world coordinates to construct the scene.

Graphical Kernel System (GKS)

It was adopted as the first graphics software standard by International Standardization Organization (ISO) and American National Standards Institute ANSI. GKS has been designed by a group of experts representing the national standards institutions of most major industrialized countries. Original GKS was 2-D and later 3-D extension was developed. The primary purpose of the standard are: To provide for portability of graphics application programs and to aid in the understanding of graphics methods by application programmers.

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Programmers Hierarchical Interactive Graphics (PHIGS):

The second standard Programmers Hierarchical Interactive Graphics Standard (PHIGS) is an extension of GKS with increased capabilities for object modeling, color specifications, surface rendering and picture manipulation. PHIGS was designed in 1980 A.D. An extension of PHIGS called PHIGS+ was developed to provide 3-D surface rendering capabilities. PHIGS is an Application programming interface standard for rendering 3-D computer graphics.

OPEN GL:

OpenGL is defined as “a software interface to graphics hardware”. It is a 3D graphics and modeling library variety purposes, CAD engineering, architectural applications, and computer-generated dinosaurs in blockbuster movies Developed by SGI. Open GL stands for Open Graphics Library. It is a Graphics Rendering

API which was developed by Silicon Graphics Inc. (SGI) in 1992. The Open GL interface consists of over 250 different function calls. OpenGL is window and operating system independent. OpenGL is a standard specification defining a cross-language, cross-platform Application_Programming Interface for writing applications that produce 2D and 3D computer graphics. It is similar to PHIGS (Programmer's Hierarchical Interactive Standard) in many ways. High performance, high quality as open GL programs capabilities allow developers in diverse market such as broadcasting CAD/CAE, Entertainment, medical imaging, and virtual reality to produce and display in credibly compelling 2D and 3D graphics. It can be used to draw complex three-dimensional scenes from simple primitives. It is an Application Programming Interface (API) for 3D programmers to create 3D objects and animate them. It is widely used in virtual reality, scientific visualization, information visualization, flight simulation, video, 3D games, 3D animation, 3D drawing applications, CAD engineering, architecture applications etc.

Importance of OPEN GL:

Open GL is popular graphical programming language which is widely used due to its open source code, elegant design and ease of use. Its source code can be easily downloaded from the internet and easily handled and use without any cost.

- Easy to use and understand.
- It is more portable between different platforms.
- A software interface to graphics hardware
- Hardware independent
- Very fast (a standard to be accelerated)
- Portable
- Simple functions to draw complex objects.

Data types Supported by Open GL:

Open GL defines its own data types. Normal 'C' data types can also be used in place of OpenGL data types, if required. Some of the data types are listed below with appropriate suffixes for literal.

Data Types of OpenGL

OpenGL Data Type	*Description*	*Suffix*	*Corresponding 'C' Data Type*
GLbyte	8-bit integer	b	signed char
GLshort	16-bit integer	s	short
GLint	32-bit integer	i	int or long
GLfloat	32-bit floating point	f	float
GLdouble	64-bit floating point	d	double
GLushort	16-bit unsigned integer	us	unsigned short
GLuint	32-bit unsigned integer	ui	unsigned int
GLubyte	8-bit unsigned integer	ub	unsigned char

[Note: All data types start with GL which denotes OpenGL. Most of them are followed by their corresponding 'C' data types (byte, int, float). Some of them have a 'u', to denote an unsigned data type.]

Open GL supports the function prototyping and special functions. Prototypes for all the Open GL functions, types, macros are contained in the header file "**gl.h"**. Microsoft programming tools ship with this files and so do most of the other programming environments for Windows or other platforms. The utility library functions are prototyped in a different file "**glu.h".** These two files are located in a special directory in your include path. This is done in the following manner:

#include<windows.h>
#include<gl/gl.h>
#include<gl/glu.h>

It was developed by experts who had lots of experience in graphics programming. They applied standard rules while naming variables, functions, datatypes etc. For examples, all the datatypes begin with GL, all the functions are named in such a way so as to identify the library file to which these belong and so on.

4. GRAPHICAL FILE FORMATS:

File format is a standard method of encoding data for storage. File format is also described as the use of format is to save an image or graphic file under the location of files and functions. There are many types of file formats, they are important because they tell programs what kind of data is contained in the file and how data is organized. File formats are of two types:

(1) Proprietary
(2) Universal

Proprietary and universal

The structure of proprietary is under the sole control of the software developer who invented the format. This file can be opened or saved without the use of an import or export filter by the program that created them.

Universal file formats are based on openly published specification and are commonly used by many different program and on different operating system. For example: Adobe Photoshop by default saves images in its proprietary format, but it can also save file in several universal formats such as TIFF , GIF , JPEG, PICT and TGA. A word processing program can read and save files in specific formats such as DOC and TXT.

SOME GRAPHICAL FILE FORMATS:

1. BMP (Windows Bitmap)
2. JPEG (Joint Photographic Experts Group)
3. TIFF (Tagged Image File Format)
4. GIF (Graphical Interchange Format)
5. PNG (Portable Network Graphics)
6. IMG (Bitmap Image)

BMP : This BMP stands for Windows Bitmap that is commonly used by Microsoft windows program (MS-DOS or Windows) and windows Operating system itself. It is a binary file. It is an image file format used to store bitmap digital images, especially on Microsoft windows and OS/2 operating system. It turns into the high pixels rate under the system of an image. It is pixel based format that only supports color. Its bit depths can be 1, 4, 8, or 24 bits. BMP is the standard MS-Windows raster format. BMP files can be created with Windows' Paintbrush', Ms-Paint type of programs and used as "wallpaper" for the background when running Windows. Microsoft Bitmap, Windows Meta File (WMF), Extended Meta File (EMF) are file formats native to the Microsoft Windows environment. BMP is very common in the Windows world, but is not cross-platform. It's not supported by professional prepress processes or by Web browsers, and so is only appropriate for internal use within the local Windows environment.

Features

Name	Windows Bitmap
DOS file extension	BMP or DIB
Compatible Operating System	Intended for Intel based PCs
Color Capabilities	2,16,256 or 16 million colors

JPEG: JPEG stands for Joint Photographic Experts Group. It is standardization committee. JPEG compressed images are often stored in a file format called JFIF (JPEG File Interchange format). It has millions of colors. It uses lossy compression to make images smaller in size. JPEG was not designed to be hardware or software specific but was introduced as a method for image compression that could be implemented in a variety of ways. JPEG compression economizes on the way data is stored and also identifies and discards extra data, that is, information beyond what the human eye can see.

Features

Name	JPEG stands for Joint Photographic Experts Group
DOS file extension	JPG or JIF
Compatible Operating System	JPEG is a compression method that can be implemented oftware and hardware on virtually any computer system
Color Capabilities	2,16,256 or 16 million colors

TIFF:

TIFF is stands for Tagged Image file format. It is standard for images that will be placed in desktop publishing programs. This file format defined in 1986 by Microsoft and Aldus and widely used in both Macs and PCs. This format is usually the best to use when exchanging bit map files that will be printed or edited further. It can be neatly transported across platforms and compressed to reduce the file size. It is device independence so that it can use on PC, MACs and UNIX workstations. TIFF is used mainly for exchanging documents between different applications and different computer platforms.

Features

Name	Tagged-Image File Format
DOS file extension	TIF
Compatible Operating System	Macintosh, UNIX etc
Color Capabilities	Monochrome (1 bit), grayscalar(4,8,16 bit) RGB color o 48 bit)

GIF: Graphical interchange format is a Bit map type which is mostly compatible for every operating system. This file format was designed by CompuServe, the online information network to provide a simple, memory

efficient format for graphics exchange. The CompuServe GIF is commonly used to upload documents to the CompuServe Information Service and to pass documents between other types of computers. It is a file format commonly used to display indexed–color graphics and images in hypertext mark-up language (HTML) document s over the World Wide Web and other online services. Actually these types of file format can open as operated by all bit map editing programs, desk top publishing software. It consists by a vector editing software. Colour capabilities as this file is indexed colour palette, up to 256 colours i.e. drawn from 24- bit RGB color.

Features

Name	Graphics Interchange Format
DOS file extension	GIF
Compatible Operating System	Most computer systems
Color Capabilities	Up to 256 colors

PNG: PNG Stands for Portable Network Graphics.. It is used mostly in web applications. The PNG format is used for lossless compression and for display of image on the World Wide Web images. PNG format supports RGB, indexed-color, gray-color scale and bitmap-mode images. Portable Network Graphics (PNG) was developed as a replacement for the GIF standard. It preserves transparency in gray scale and RGB images. PNG is superior to GIF in many ways, offering the following features:

- Images that are the same size or slightly smaller than their GIF counterparts, while keeping lossless compression
- Support for indexed colors, gray-scale, and RGB (millions of colors)
- Support for 2-D progressive rendering, which is based on pixels rather than lines (as in interlaced GIFs and progressive JPEGs); this means that contents of a progressively rendered PNG file become apparent earlier in the load process

IMG: This file format is an image file format used to store bit map digital images on Graphical Environment Manager. This file format is a CD or DVD image file. An archive format used to creating a disk image as floppy disks and Hard disks files create a using this format use the "IMG" extension. These types of format created by use various graphics software packages. This IMG file contains a row dump as the content as a disk. New Burning Rom supported reading of IMG file for creating bootable CD. IMG files were originally designed to work with the GEM Paint Program. GEM, a graphical user interface, was created to run on both the IBM PC and the Atari ST. IMG files handle monochrome and gray level images.

Features

Name	GEM Bitmap Image
DOS file extension	IMG
Compatible Operating System	Atari ST and IBM PC
Color Capabilities	2,16,256 or 16 million colors

UNIT: 7 INTRODUCTION TO MULTIMEDIA

1. INTRODUCTION TO MULTIMEDIA:

Multimedia is the technology of presenting information in more attractive, interesting and understandable manner by integrating or combining of multiple forms of media elements. The "multimedia" word is made up of two words "multi" and "media" where multi refers to more than one and media refers to the way through which one can express information. It may include several media elements like text, spoken audio or sound, voice, music, images, animation and video. For example: a presentation involving audio and video clips would be considered as a multimedia presentation. Educational software that involves animations sounds and text is called multimedia software. Multimedia programs are often interactive and include games, presentations, encyclopaedia and many more.

The technology of combining speech, hypertext, text, still graphics, animation, moving pictures and sound using the computing power of PC is known as multimedia. Multimedia requires the large amount of data to be stored. One of the cheapest, portable and high storage disks are Compact dices (CDs) such as Multimedia CD, Encyclopaedia CD, Tutorial CD, TOFEL CD ete. are examples of multimedia products.

Advantages of Multimedia:

- It helps to create effective presentation and tutorial material for all subjects.
- It is very portable so that it can be used at any time anywhere by anybody.
- Very easy to use, handle, carry, copy and store.
- Very helpful to transfer messages and advertisements in WWW.
- It provides very powerful presentation tools with colored pictures, motion pictures and other.

Disadvantages of Multimedia:

- Very expensive installation cost.
- Require a well trained manpower or technician.
- Expensive hardware components.
- Inaccessible to poor due to high cost.

MULTIMEDIA TECHNOLOGY:

Multimedia technology is a special computerized technique, which helps the user by providing techniques to combine texts, pictures, sound and video films including interactive facilities. It also provides facilities to the user to create store, edit, delete and copy those data in the computer with the help of specific computer program such as Microsoft Power point, Adobe Acrobat, Macromedia Flash etc.

MULTIMEDIA SYSTEM:

Multimedia system is a system which have all the necessary hardware and software components and that can handle or present more than one medium such as text ,graphics, sound, video and animation in an attractive way simultaneously. A multimedia computer system has the capacity to handle or present more than one medium simultaneously. A multimedia computer contains all the hardware and software required for creating, playing and editing multimedia object. A multimedia PC is a computer that has a CD-ROM or DVD drive and supports 8-bit and 16-bit waveform audio recording and playback, MIDI sound synthesis, and MPEG movie watching, with a central processor fast enough and a RAM large enough to enable the user to play and interact with these media in real time, and with a hard disk large enough to store multimedia works that the user can create. Multimedia system performs the functions of inputting data, development the system and outputting meaningful output. Data input from sources as cameras or musical instruments, application development and data output to some delivery medium such as video disk or CD-ROM.

The multimedia system hardware components are:

1. Computer set
2. Multimedia software
3. Sound card/Video adapter
4. CD-Drive
5. Micro phone
6. CD - ROM Disk
7. Speakers / Head phones
8. Digital camera
9. Multimedia Projector
10. Blue - ray Devices

The multimedia should have sound card, speakers, high resolution monitor, high speed microprocessor, large RAM capacity, high storage memory containing system with suitable multimedia software.

Some of the multimedia software:
Popular multimedia authoring software includes Macromedia Author Ware, Macromedia Director, and Macromedia Flash.

1. Adobe photo shop : It is used in creating graphics.
2. Macromedia flash, Animator pro : It is used in creating 2D graphics.
3. 3D studio, Max-Maya : It is used in creating 3D animations.
4. MS-Power Point : It is used in creating presentation.

All or some of the above mentioned components work together to make up the multimedia system which can capture, digitize, compress, retrieve, the multimedia contents or data and show it into the output devices like computer monitor or multimedia projectors etc.

Image Editors or Software such as:
- *Adobe Photoshop*
- *PhotoDeluxe*
- *CorelPhotopaint*

Drawing programs or software such as:
- *Macromedia Freehand*
- *Adobe Illustrator.*
- *Core Draw*

Paint program format such as:
- *Bit Mapped Graphics (BMP or Windows Bitmap.*
- *Graphics Interchange Format (GIF).*
- *Joint Photographic Expert Group (JPEG).*
- *Protable Network Graphics (PNG).*

Video Editors Software and format such as:
- *Motion Picture Experts Group (MPEG-2)*
- *Quick Time (Format)*
- *Video for windows (AVI format)*
- *Adobe premiere software*
- *Video VisionML Software*
- *Video Vision Studio Software*
- *Avid Cinema Software*
- *Fusion Recorder Software*
- *Maya Software*

Audio software and format such as:
- *MP3 format*
- *Sun/Next (AU) sounds.*
- *Microsoft Windows Wav sounds format.*
- *Musical instrument digital interface (MIDI) format.*
- *Sound Forge (Sound Editor)*
- *SoundEdit (Sound Editor)*
- *Multimedia Deck (Sound Editor)*

CD-ROM TECHNOLOGY:

A compact disk or CD is a thin water of clear Polycarbone plastic and metal, with a small hole (hub) in its centre. CD-ROM is a Compact Disc Read Only Memory that contains data accessible by a computer. CD-ROMs are popularly used to distribute computer software, games and multimedia applications. Though any data can be stored according storage capacity at the disc. A standard 120 mm CD-ROM holds 650-700 MB of data. CD-ROM disc can be mass produced for pennies and can contain up to 84 minutes of full screen video or audio. Most personal computers available today include a CD-ROM player. Multi-layered Digital Versatile Disk (DVD) technology is on the way toward general usage and will increase the capacity and multimedia capacity of current CD-ROM optical technology.

What is hypermedia?
A set of documents in which a given document can contain text, graphics video and audio clips as well as embedded references to other documents World Wide Web pages are hypermedia documents.

What is hypertext?
Hypertext is an application of indexing text to provide a rapid search of specific text strings in one or more documents. Hypertext is an integral part of hypermedia documents. In multimedia applications, a

hypermedia documents is the basic complex object of which text is a sub-object. Other sub-objects in the basic object include images, sound, and full-motion video.

2. APPLICATION AREAS OF MULTIMEDIA:

Multimedia technology is used in games, learning software, reference materials like encyclopaedia, movies, web pages, advertisement, virtual reality and some other fields. Its use is growing in computer based education (CBE) and computer based tanning (CBT). Multimedia is widely used in video games, electronic newspapers and magazines, electronic books and references, simulations, virtual reality, and computer-based training. Now a days computer's use is increase day by day and almost all sector of the world is computerized and use of multimedia technology is also increase. Some of the above fields are listed below:

1. Multimedia in Education & Training
2. Multimedia in Business
3. Multimedia in Advertisement
4. Multimedia in Games and Movies
5. Multimedia in Virtual reality
6. Multimedia in Internet

Multimedia in Education & Training: The use of multimedia in education is increasing rapidly. Multimedia enables students to grasp the concept easily and quickly and retains the information for longer time. Education multimedia CD helps to learn different topics. Distance education and Open University use multimedia technology to teach their students. The use of Encyclopaedia CD,TOFEL, IELTS, Dictionary etc. are the examples of involvement of multimedia in education field. For the office staff and employees training and orientation programs various Multimedia elements are using by several companies and organisation.

Multimedia in Business:

To convey and present information about business or products multimedia is used in business. Various organisations use multimedia to provide interactive training to their employees through the CDs or network. Video conferencing provides virtual face-to face communication among the people sitting at different places or locations. All the locations simultaneously receive the audio, video, or data that one location transmits. To make attractive advertisement of a product multimedia technology is used. Now days online selling -buying service of internet also used by various companies with attractive multimedia effects.

Multimedia in Advertisement: With the use of multimedia advertisers find new and creative ways of advertising and marketing products. Everything that the human mind can imagine can be represented realistically through the use of multimedia.

Multimedia in Games and Movies:

Multimedia is used in video games such as snake and ladder, Prince of Persia, PC man etc. In many movies, special effects are kept with the help of multimedia technology. For example, Terminator, Titanic, Star wars, Jurassic Park, King Kong, Godzilla etc. are some English movies where special effects are used**.**

Multimedia in Virtual Reality:

Virtual reality is an artificial environment created with the computer hardware and software and presented to the user in such a way that appears real. It is primarily used in the entertainment industry but it is going to be very useful tool for remote control applications and simulation purpose. Creation of 3D animations and games to control flying and running items is virtual reality. Some time while using such multimedia with Head-Mounted Display (HMD), a helmet like contraption equipped with stereo LCD displays. We feel like exploring in the room or earth in a very complex virtual environment. The most advanced immersive technology to date is the Cave Automotive Virtual Environment (CAVE). In WWW Virtual Reality Modelling Language (VRML) is used to create such virtual reality animation. It is mostly used in computer games to give real experience in virtual environment.

Multimedia in Internet: Multimedia technology is widely used in the internet. Informations in web sites are presented beautifully using multimedia technology.

CREATING MULTIMEDIA:

When we have proper hardware supporting system and software system with the complete idea and perfect skill of multimedia then we can think about the production of multimedia. Every project like multimedia project is also completed with the various stages and sequential steeps. Some of the stage should be completed before other stages begin and some stages may skip or combined. The process of multimedia work involves several steps like planning the work, creating and collecting the elements to

be included in the work, combining the elements to create the work, testing, evaluating the refining the work , writing the work to a portable storage medium such as a CD-ROM or posting the work on the web. Some major stages in the multimedia project development are written and explained below:

1. Planning and Costing
2. Designing and Producing
3. Testing
4. Delivering

1. Planning and Costing: A project always begins with an idea or a requirement that we refine by its messages and objectives. Before we begin development, we must plan about the requirements of the project such as writing skills, graphic arts, music, video and other multimedia exercise will be required. Estimate the time needed to do all elements and prepare a budget.

2. Designing and Producing: Perform each of the planned tasks to create a finished product.

3. Testing : Always test your programs to make sure they meet the objectives of our project and they work properly on the intended delivery platforms and they meet the needs of the end user.

4. Delivering : Package and deliver the project to the end user.

There are three common ways to organize or planning the multimedia work. They are as follows:

- **Sequential page based multimedia:** The simple pages which containing slides of text, pictures, still graphics, videos is called sequential page based multimedia. This type of multimedia presentation is used in college and school for lecture and advertisement in sales company and other various purposes.
- **Hypertext based multimedia:** This type of multimedia is attached with hypertext document in the web. It provide link to the containing folder or files or pictures and articles. Any type of multimedia can be used such as graphics, sound, video animation.
- **Movie based multimedia:** the work can be a movie or series of movies that stop from time to time to enable the user to follow a link.

3. MULTIMEDIA TEAM /[PORJECT DEVELOPMENT TEAM]:

A typical team for developing multimedia for CD-ROM or the web consists of people who bring various capabilities to the table. Often, individual members of multimedia production teams wear several hats: graphic designers may also do interface design, scanning, and image processing. A project manager or producer may also be the video producer or script writer. Depending upon the scope and content of project and the mix of people required. A multimedia production required team members (18 members) according to Wes Baker, a professor at Cedarville University in Cedarville, Ohio:

1. Executive Producer
2. Producer/Project Manager
3. Creative Director/Multimedia Designer
4. Art Director/Visual Designer
5. Artist
6. Interface Designer
7. Game Designer
8. Subject Matter Expert
9. Instructional Designer/ Training Specialist
10. Script Writer
11. Animator (2D/3D)
12. Sound Producer
13. Music Composer
14. Video Producer
15. Multimedia Programmer
16. HTML Coder
17. Lawyer/ Media Acquisition
18. Marketing Director

PROJECT MANAGER:

A project manager is a person who is responsible to develop, manage and implement a good project with coordination of project team. A project manager's role is at the center of the action. Project manager integrates people from various functional areas to achieve specified project goals. He or she is

responsible for overall development and implement of a project as well as for day-to-day operations. His or her duties are to prepare the budgets, schedules, creative sessions, time management, invoices and team dynamics. A good project manager must completely understand the strengths and limitations of hardware and software so that he or she can make good decisions about what to do and what not to do. Project manager must demonstrate leadership and provide the motivation necessary to accomplish the task required. Project manager also evaluates progress and tasks and appropriate action is taken when the project schedules are in trouble. The project manager must have people skills, organisational skills and attention to all the myriad details of a project.

MULTIMEDIA DESIGNER:

A multimedia project needs to be truly interactive, attractive, good looking and engaging. Screen should present an appealing mix of color, shape and aesthetic. A project should have navigation clues clear and consistent, icons should be meaningful, screen elements should be simple and easily understandable and operatable by the viewers. Graphic designers, illustrators, animators and image processing specialists deal with the visuals. The project must meet the needs of the end user.

A multimedia designer is a person who has roles of making attractive, pleasing, aesthetic and good looking project. He or she looks the overall contents of a project, creates a structure for the content, determines the design elements required to support that structure and decides the Me dias which appropriate for presenting the project. Multimedia designer is sometimes called an information designer who prepares the blueprint for the entire project content, media and interaction. Multimedia designers need a variety of skills.

INTERFACE DESIGNER:

Like a good film editor, an interface designer's best work is never seen by the viewer. An interface provides control to the people who use it. It also provides access to the media of multimedia like text, graphics, animation, audio, and video. The result of an interface designer's work is the multimedia title screen, effective use of windows, backgrounds, icons and control panels.

The role of an interface designer is to create a software device that organizes the multimedia content, that lets the user access or modify that content and that presents the content on screen. The three areas of interface design are information design, interactive design and media design. In the real world , design responsibilities are often assigned differently depending on the project. Sometimes all the design works are given to a person and sometimes divided among the group members. An interface designer may also be multimedia designer or the graphic designer. A good interface designer creates a product that rewards exploration and encourages use.

WRITER:

Multimedia writers do everything writers of liner media do, and more. They create character, action, and point of view -a traditional scriptwriter's tools of the trade- and they also create interactivity. They write proposals, they script voice-overs and actor's narrations, they write text screens to deliver messages, and they develop characters designed for an interactive environment.

Writers of text screen are sometimes referred to as content writers- they glean information from content experts, synthesize it, and then communicate it in clear and concise manner. Scriptwriters write dialog, narration and voice-overs. Both often get involved in overall design. The role of the writer changes with each different project which depends on the project team members. Multimedia writing is always different from writing a film or video script. In film or video script, writer is plotting a story according the dramatist or novelist way. But, multimedia writing is difficult it is smaller and more discrete process that have to interrelate to each other which have to be compiled into a puzzle of sorts.

VIDEO SPECIALIST:

A video specialist on a multimedia project may be just one person and a commander. A video specialist may be responsible for an entire team of videographers, sound technicians, and lighting designers, set designers, script supervisors, gaffers, grips, production assistants, and actors. The multimedia project, a video specialist must be a seasoned professional, skilled in managing all phases of production, from concept to final edit.

The multimedia video specialist must familiar with the tools and techniques used for shooting good video, Editing and mixing the project on computers. Since 1990s, the digital video p resentation methods like Apple's Quick Time or Microsoft's Video for Windows etc. type of systems are using by the

multimedia developers. The video specialist also must have knowledge about video compression, portability, platform independence transferability to the different environment. The video specialist also must skilled to present video and audio quality, video color structure, lighting, shading and video clarity.

AUDIO SPECIALIST:

The quality of audio elements can make or break a multimedia project. Audio specialists are the wizards who make a multimedia program, task of designing and producing music, voice-over narrations, and sound effects. They perform a variety of functions on the multimedia team and may enlist help from one or many other members like composers, audio engineers, or recording technicians. Audio specialist may be responsible for locating and scheduling suitable music, scheduling recording sessions, and digitizing and editing recorded material into computer files.

A multimedia audio or sound specialist must have understanding of the needs and requirements involved in producing successful sound tracks. The specialist can be an engineer, technician, composer, sound designer, or any skilled person of all of them.

MULTIMEDIA PROGRAMMER:

A programmer is a person or an expert who performs the activities of writing computer program or computer instructions to perform any task or to solve any particular problem. A multimedia programmer or software engineer or expert integrates all the multimedia elements of a project into a complete package by using any appropriate computer programming language. The programmer on a multimedia team is called on to perform a number of tasks from assisting producers in organizing their code more effectively for enchasing the production and playback tools. Multimedia programming functions range from coding simple displays of multimedia elements for controlling peripheral devices such as laserdisc players, managing transitions, keeping records and managing complex timing for the object component actions. The most important skill of a multimedia programmer can bring to a team is the ability to quickly learn and understand the producing system. Creative multimedia programmers can coax extra and surprising performance from multimedia programming system. They must have interactive programming skills and expertise in multimedia related programming language like C,C++,Lingo, Java Script, Open Script, Author ware etc.

PRODUCER: MULTIMEDIA FOR WEB

Web site producer is a new occupation. Web site is never finished, but it should indeed, remain dynamic, fluid and alive. Web site is available for tweaking at any time. Web site producer is responsible for developing web projects from concept through implementation for internal and external clients of web. He or she required the knowledge of HTML coding, knowledge of CGI scripting, knowledge of image processing software like Photoshop. Now a days available various web designing software like PHP, dot Net,

THE SUM OF PARTS:

The multimedia project can be completed by completing all the stages and procedures step by step using several development tools, techniques and methods by a complete team. Successful multimedia projects begin with selecting "team players". The project team is a group of people often differential functional areas or organizations. Team binding process must continue through project duration. Team binding is an activity that helps a group and its members function at optimum levels of performance by creating work culture incorporating the work distribution according to their talent, expertise and personality. The size and constituency of the team may fluctuate during the life of the project. Well-developed team skills are more successful for the best project development. A project manager initiates team-binding task with their roles in the project.

UNIT: 8 MEDIA SOFTWARES

1. MULTIMEDIA BASIC TOOLS

The basic tools set for building multimedia projects contain one or more authoring systems and various editing applications for text, images, sounds, and motion video. A few additional applications are also useful for capturing images from screen, translating file formats, and moving files among the computers. These multimedia software are able to of paint, image processing image editing, drawing illustration, 3-Dimension (3D), Computer Assisted Design (CAD), optical character Reader (OER) and text editing, Sound Receding and editing videos and movie making a often tasks. The basic tools those are required for the multimedia Software:

- Text Editing & Word Processing Tools
- Painting & Drawing Tools
- Image – Editing Tools
- Sound Editing Tools
- Animation, video & Digital Movie Tools

TEXT EDITING AND WORD PROCESS TOOLS

Text editing and word processing software are the important tools for text, character or symbol editing the multimedia object or document in multimedia product title and other contents text formatting, text and symbol designing etc. can be done by using word processing software. With text documents we can embed symbols, pictures, charts etc. Microsoft-word, word star, word perfect, Aldus page maker Sabdratna , etc. are Popular word processing software.

"Word Processing Software is one of the Powerful application Software that is widely used for preparing personal and official documents like notes, letter, memos reports, books etc. Word processer such as Microsoft -Word and Word Perfect are powerful applications that include text editing and formatting, spell and grammar checkers, table insertion and formatting, object linking and embedding, prebuilt templates and designs, symbols and picture editing and insertion etc. features.

Features of Word processing applications:

- Word processing programs provide the Desktop Publishing features.
- User can create the text documents and edit them later.
- Provide easy way for modifying the existing text, deleting/moving some part of it.
- Provide easy environment to maintain the Font size, Font styles and type of fonts.
- Provide features of including Page numbers and Header and Footer in the current document.
- Spelling can be checked and correction can be made automatically in the entire document.
- Also allow the user to mix the graphical pictures, Clips, Arts with the text.
- Tables can be created, modified and included with the text.
- Also provide the mail-merge facility.
- Support Security and privacy maintenance with the documents.
- Provide online help of any option.

PAINTING AND DRAWING TOOLS:

Painting and drawing software applications are also important tools for image creating, editing and designing for multimedia objects. These software applications are sometimes called graphics applications which allow users to change the size of photos, brightness, color, contrast, crop, rotate, flip and compressing the images. These applications are categorized according to their unique features. Painting software such as Photoshop, Fireworks and Painters are designed for producing crafted bitmap images. Drawing software such as Corel Draw, Adobe Picture Ready, Free Hand, Illustrator, Designer and Canvas are dedicated for producing vector-based line art easily printed to paper at high resolution. Some software applications combine drawing and painting capabilities. Some vector-based packages such as Macromedia's Flash etc. are aimed to contain both bitmap and drawing art.

Features of Painting and Drawing Tools:

- Contain GUI with pull down menus, shortcut keys, status bar, palette control and quick selection dialog box.
- Scalable dimension, resize, stretch and distort large and small bitmaps.
- Contain paint tools to create geometric shapes like square, circle, rectangles, curves and polygons.
- Contain zooming, resizing, cropping, color management, paint with pattern and clip art.
- Contain file importing, exporting and interchanging capabilities.

3D MODULING & ANIMATION TOOLS:

Three-dimensional, term used to describe a figure that has length, width, and depth. For example, a geometric solid such as a cube or sphere is a three-dimensional figure.

Three-Dimensional Image, or 3-D image, flat image enhanced to impart the illusion of depth. Humans perceive the world and the objects in it in three dimensions—breadth, width, and depth. This seemingly simple phenomenon is the product of a complicated set of interactions between our eyes and our brains that is still not entirely understood. Our eyes are spaced about 6 cm (2.5 in) apart, which causes each eye to receive a slightly different image. The brain fuses these two images into a single 3-D image, enabling us to perceive depth. This way of seeing is called binocular vision, or stereoscopic vision

Hollywood filmmakers first used 3-D computer graphics in movie shorts in the 1970s but did not apply the techniques to a major feature film until 1982 in the science fiction hits *Star Trek: The Wrath of Khan* and *Tron*. Techniques for 3-D computer animation rapidly grew more sophisticated and more common. In 1995 *Toy Story* became the first feature film in which all of the images were created entirely with computers.

3-D Modelling software has increasingly entered the mainstream of graphic design as its ease of use improves. With 3-D modelling software, objects rendered in perspective appear more realistic, the user can create stunning scene and wander through that. Powerful modelling application packages such as AutoDesk's Discrete, Strata Vision's 3D , Specular's Logo Motions and Infini-D, Akias' Wavefront, Avid's SoftImage, and Caligari's true Space are also bundled with assortments of pre-rendered 3-D clip art objects like people, furniture, buildings, cars, airplanes, trees and plants. Specialized applications for creating animation 3-D text are Fontographer, PostScript, True Type, Master fonts etc. are some programs to maintain interesting effects in the text. Each rendered 3-D image takes from a few seconds to a few hours to complete that is depending upon the complexity of the drawing and the number of drawn objects included in it.

Features of 3-D Modelling Tools:

1. Its multiple windows allow to view created model in each dimension.
2. It has ability to drag and drop primitive shapes into a scene.
3. It has ability to create any complex object with Bezier spline drawing tools.
4. It has lathe and extrude features.
5. Color and texture mapping.
6. It has ability to add realistic effects like transparency, shadowing and fog.
7. Unlimited cameras with focal length control.
8. It has ability to draw spline-based paths for animation.

IMAGE-EDITING TOOLS:

Image-Editing applications are specialized and powerful tools for enhancing and retouching existing bitmapped images. These applications also provide many of the features and tools of painting and drawing programs and can be used to create images from scratch as well as images digitized from scanners, video frame-grabbers, digital cameras, clip art files, or original artwork files created with a painting or drawing package. Some of these applications are interchangeable of file format.

Features of Image-processing Tools:

- Provide multiple windows to view several images at a time.
- Provide features of image file conversion and format interchange.
- Allow direct import of images from scanning and peripheral devices.
- Provide good masking features.
- Provide undo and restore features.
- Provide image color management, balance control, re-sampling and resizing features.
- Provide special effects plug-ins, geometric transformations, image design in several layers etc.
- Provide various tools like selection tools, tools for blurring, sharpening, darkening, tinting etc.
- Provide features for transferring images over electronic media.

SOUND-EDITING TOOLS:

Sound editing applications widely used for digitized and Musical Instrument Digital Interface (MIDI) sound. These applications allow user for representing sound in fine instruments, cut, copy, paste, mix and modify sound pattern. Using sound editing software the user can make his/her own sound effects and install and use that. The sounds are shipped with both Macintosh and Windows Operating system environment. In any version of Windows operating system shipped as the Sound Recorder Program with feature of sound editing. The user can incorporate MIDI sound files into their multimedia project.

Many MIDI programs provide both sequencing and notation capabilities to edit both digital audio and MIDI within same application. Quick Time Player, Microsoft Sound Recorder, Sonic Foundry's Sound Forge etc. are some sound editing tools.

OCR SOFTWARE:

OCR stands as Optical Character Recognition or Optical Character Reader. It is a type of data scanning devices or data input devices. OCR Software is controls OCR device and reads and generates scanned text or matters in to the computer in digital form. A scanning device is typically used to create the bitmap then the software breaks the bitmap into chunks according to whether it contains text or graphics, by examining the texture and density of area of the bitmap and any detecting edges. OCR applications claim about 99% accuracy when reading 8 to 36 point printed characters at 300dpi (dots per inch) and can reach processing speed of about 150 characters per second. Example of this OCR software is OmniPage Pro. With this type of software, the formatting and layout of the original document can be recognized and imported into Microsoft word with styles and several fonts.

ANIMATION, VIDEO AND DIGITAL MOVIE PLAYERS (TOOLS):

Animations and digital video movies are sequences of bitmapped graphic scenes or frames. But animations can also be made within the authoring system by rapidly changing the location of objects or sprites to generate an appearance of motion. Most of the authoring tools adopt either a frame or object-oriented approach to animation. Moviemaking tools typically take advantages of Quick Time for Macintosh and Windows and Microsoft Video for Windows technology. These applications let user to create, edit and present digitized motion video segments. To make movies from videos mostly we required special hardware components to convert analog video signal to digital data. Premiere, Video Shop, Media Studio Pro and Windows Movie Maker etc movie making tools allow user to edit and assemble video clips captured from camera, tape, other digitized movie segment, animations, scanned images, and from digitized audio or MIDI files. The completed clip can be modified with added transition and visual effects and played back.

2. MULTIMEDIA AUTHORING TOOLS:

"Authoring tools" *cover* any software is used to write the web, from enterprise content management systems (CMSs) through to micro blogging mobile applications, whether web-based, non-web-based or a combination. Any software, or collection of software components, that authors can use to create or modify web content for use by other people, is an Authoring Tool. Authoring tools, at their best, should allow all of us to publish to a universal space of web content, read by people from all over the world, in many different languages, on many different computers, using many different input and output devices. Authoring tools are an essential element in achieving a universal, accessible web. The ideal authoring tools produce accessible, robust web content, regardless of the technical knowledge of the content authors. The multimedia authoring tools provide the framework for organizing and editing the elements of a multimedia project. These authoring software tools provide an integrated environment for combining the contents and functions of a project. These tools enable the developer to combine text, graphics, audio, video and animation into an interactive presentation or project. Authoring systems include editing tools to create, edit and convert multimedia elements such as animation and video clips. These tools include all the features related to import and embed specific data and information. The organisation, design and production process for multimedia involves storyboarding and flowcharting. Visual flowcharting or overview facility illustrates project structure at a micro level. By using multimedia authoring software user can make video productions, animations, games, interactive web sites, demo disks and guided tours, presentations, kiosk applications, interactive training, simulations/prototypes and technical visualizations.

- Multimedia authoring tools provide the framework for organizing and editing the elements of a multimedia project.
- Authoring software provides an integrated environment for combining the content and functions of a project.
- It enables the developer to create, edit, and import data.

Features of Multimedia Authoring Tools:

- Editing and organizing features
- Programming features
- Interactivity features
- Performance tuning and playback features
- Delivery, cross-platform and internet playability features,

Editing and organizing features:

The element and building blocks of multimedia like images, animations, text, digital audio, MIDI music and video clips required to be created, edited and converted to standard file formats using the specialized applications. Multimedia editing and organizing features of multimedia authoring system support to produce interactive and attractive multimedia product. These features involve organising the product plan into several storyboarding and flowcharting.

Programming Features:

Multimedia authoring systems offer one or more of the approaches like visual programming (with cues, icons and objects), programming with scripting language, programming with traditional language such as C language/BASIC, document development tools etc. Visual authoring tools like visual programming with icons or object are perhaps the simplest and easiest authoring process. Visual authoring tools like Authorware and Adobe's Acrobat Direct are particularly useful for slide shows and presentations. Some of the authoring tools like Adobe Acrobat Connect, Flash, Tool Book and Runtime Revolution's Runtime etc. offer a very high level language (VHLL) with interpreted scripting environment for navigation control. The more advance commands and functions provided in the scripting language. Some authoring tools offer direct importing of pre-formatted text, indexing facilities, complex text search mechanisms, hypertext linkage tools. These authoring systems are useful for development of CD-ROM information products, online documentation and help systems and sophisticated multimedia-enhanced publications. With these tools user can perform computational tasks, respond user input, create character, icons, and motion animations, launch other applications and control external multimedia peripheral devices.

Interactivity Features:

An interactivity feature of authoring tool empowers the end users of the project by letting them control the content and flow of information. Authoring tools should provide one or more levels of interactivity like simple branching, conditional branching and structured logic. Simple branching offers the ability to go to another section via activity of key press, mouse click or expiration of a timer of the multimedia production. Conditional branching supports to go to based on the results of IF-THEN decision or events. A structured logic supports nested IF-THENs, subroutines, event tracking and message passing among objects and elements.

Performance Tuning & Playback Features:

According to the complexity of the multimedia project there is required exact synchronization of events. Some multimedia authoring tools allow user to lock the production's playback speed to a specified computer platform. In many cases, user required to use the authoring tool's own scripting language or custom programming facility to specify timing and sequence on systems with different faster or slower processors.

Multimedia Authoring tools should let user to build a segment or part of project and quickly test as actually using it.

Delivery, cross-platform and internet playability features:

The prepared project should be easily distributed. When user is distributing the project, that should distribute in the run-time version because standalone version does not support advance authoring tools or systems.

It is also important to use tools that make transfer project across platforms easily. The project is called good when it is accessed and transformed from one platform to another platform without any extra resources. If users develop on a Macintosh, look for tools that provide a compatible authoring system for Windows or offer a run-time player for the other platform. iShell sytem employs platform-independence Extensible Markup Language (XML) to make compatibility. Adobe Acrobat Connect allows user to create project in almost any environment.

Multimedia Authoring Systems typically provide a means to convert their output which can be delivered within the context of HTML/DHTML, JAVA script. User required for testing the authoring software for Internet delivery before finalizing the project.

TYPES OF AUTHORING TOOLS:

1. Card-based /page-based tools
2. Icon-based/Event -driven tools
3. Time-based tools
4. Web based authoring tools.

Card-based /page-based tools:

Card-based and page-based authoring tools are the types of multimedia authoring tools or systems that provide a simple and easier way for organizing multimedia elements. In these types of systems graphics images typically formed the backbone of the project. They are useful when elements of the project allow individual viewing, just like the book pages. Navigation routines consist of going to a page or card that contains appropriate images and text, and associated sounds, animations, and video clips. Page based authoring systems contained media objects with the buttons, text fields, graphic objects, backgrounds and pages or cards. The characteristics of objects are defined by properties like highlighted, bold, red, hidden, active, locked, and so on. Most page-based authoring systems provided a facility for linking objects to pages or cards. Hyper Card, Revolution and Tool Book are the authoring systems consist of several features to create and produce the project. Card and Page-based systems typically provided two separate layers on each card: background layer and foreground layer. These authoring tools are object-oriented. All elements - buttons, text fields, backgrounds, pages or cards, audio clips, video clips and even the whole project - are treated like objects. Objects have properties, that define their characteristics. As far as most authoring systems support a scripting language for more sophisticated applications, every object may have a program code, in the appropriate authoring tool script. The most popular authoring tools from this group are the HyperCard for Macintosh and the Multimedia Toolbook for PC/Windows platform.

Icon and Object based Authoring Tools:

Icon based and object based or event driven tools provide a visual programming approach to organize and present multimedia. First user creates a structure or flowchart of events, tasks and decisions by dragging appropriate icons from a library. These icons can include menu choices, graphic images, sounds and computations. With icon-based authoring tools, non-technical multimedia authors can build sophisticated applications without scripting. Like Authorware, Allen Communication's Quest is a visual design environment for organizing media objects with particular features that enhance courseware and training development.

There are both good and bad aspects to icons for Computer Based Training (CBT) projects. Icons help you visualize the content of a project, and they can be easy to manipulate for simple projects. However, if the icons grow too numerous, they become confusing. Icons are not substitutes for programming. There is no way an authoring system can have enough icons to support all the things needed by CBT developers. Attempts to do so typically result in projects with a mind-numbing array of indistinguishable icons. That's where available programming comes in. Authorware Professional for Macintosh/Windows and Icon Author for Windows are icon-based authoring tools for multimedia content creation.

Time-Based Authoring Tools:

Time-based systems are popular multimedia authoring tools. Each uses its own distinctive approach and user interface for managing events over time. Many use a visual timeline for sequencing the events of a multimedia presentation. These tools support arrange long sequence of graphics frames, add time components by adjusting duration of play of each frame.

Time-based authoring tools are often regarded as the most common multimedia authoring tools. Elements and events are arranged and organized according to periods of time. Each tool from this category uses its own, distinctive approach and user interface for managing events over time. Many use a visual timeline for sequencing the events of a multimedia presentation, often displaying layers of various media elements or events alongside the scale in increments as precise as of a second. Others arrange long sequences of graphic frames and add the time component by adjusting each frame's duration of play.

Macromedia Director:

- A multimedia database, 'Cast', contains still images, sound files, text, shapes, scripts, movies, and other Director files.
- Score is a sequencer for displaying, animating, and playing Cast members.
- Lingo is an object-oriented scripting language that enables interactivity and programmed control.

Macromedia Flash:

- Flash is used for delivering rich multimedia content to the Web.
- It allows the creation of simple static HTML pages with the Flash Player plug-in.

Web Based Authoring Tools:

Web authoring tools can provide the power to build an interactive, animated, state-of-the art Web site suitable for anything from a personal Web page to midsize business site. Web designers don't need to know HTML to create discussions groups, pop-up windows, navigation bars, animated page transitions,

Dynamic HTML or a dozen other advanced features in order to integrate them into a site with an elegant and consistent design. There are main three Web Authoring tools: NetObjects Fusion, Microsoft FrontPage and Macromedia Dreamweaver. These tools support to design several web documents with advance tools and techniques. The advance version of Web based authoring tools are Microsoft FrontPage 2000, Macromedia Dreamweaver 3, and NetObjects Fusion 5.0 now share many common features.

Types of Web Authoring Tools:

Pure WYSIWYG (What You See Is hat You Get: pronounced"wiz-ee-wig") editor: With a pure WYSIWYG editor, you work entirely in an interface that resembles a desktop publishing program. These programs are best suited for those wanting a great looking site that's not very hard to build. NetObjects Fusion and Drumbeat are examples of WYSIWYG editors.

Pure code-based editor: With pure code-based editor, you work directly with raw HTML tags and set your own rules about how to lay out and organize your code. You have total control over you code. HomeSite, HotDog Professional, HTMLed Pro, WebberActive, and WebEdit examples of pure code-based editors.

Compound editor (Pure WYSIWG editors + Pure code-based editors): With a compound editor, you can accomplish most tasks in a WYSIWG editing mode but switch from the word processor-style editing window to a source code view to modify the page's underlying HTML. Macromedia Dreamweaver, Microsoft FrontPage, QuickSite, and Visual Page are examples of compound editors.

Cross-Platform Authoring tools:

- Macintosh and Windows computers use different schemes to manage text and colors.
- While using text fields, ensure that the text displays correctly on both platforms.
- Outline and shadow styles on text should be avoided on Macintosh since they are not currently supported in Windows.

UNIT: 9 MULTIMEDIA BUILDING BLOCKS

1. MULTIMEDIA BUILDING BLOCKS: INTRODUCTION

To convey information effectively and interestingly all the components of multimedia must be used properly. The ability to access information stored as different media depends on the availability of standard data formats that is understood by most applications in use. Proprietary formats are typically more compact compared with open standard formats. Open and non-proprietary standard formats can be used in all the applications. Multimedia building blocks sometimes also referred to as components of multimedia or elements of multimedia. These components are integrated to each other to create or manage an interactive and attractive multimedia object or multimedia project. When individual components are used to create a project that does not look good or perfect but when these all the components are combined with each other to create a project that looks complete and perfect project which retains longer in memory of the people.

Producing a multimedia application requires careful handling of its various building blocks. It's only after knowing the details about these elements, that a designer will be better equipped to employ them effectively to sophisticated applications. A striking multimedia presentation can be created weaving together the building blocks of multimedia like attractive images and animations, engaging sounds, appealing video clips and textual information.

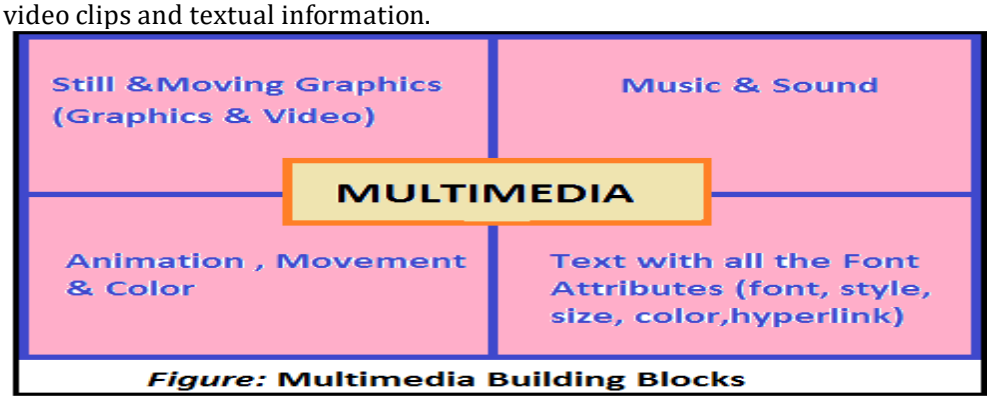


Figure: Multimedia Building Blocks

1. Text
2. Sound or Audio
3. Picture or Image or Graphics
4. Video
5. Animation

1. **Text:** Text is the primary component of multimedia. Most of the information is conveyed through the text. The use of different styles, fonts and colors can be used to emphasize the texts. The text can be formatted with various tools and combined with other media components to present information attractive and interactive. There are three types of text that are used to produce pages of documents: Unformatted text or plain text, Formatted text or rich text and Hypertext. Unformatted text enables pages to be created which comprise of strings of fixed-sized characters from a limited character set. Formatted text enables pages and complete documents to be created which comprise of string of characters of different styles, size and shape with tables, images and graphics inserted at appropriate points. Hypertext enables an integrated set of documents to be created which have defined linkages between them.

Use of Text in Multimedia:

1. Text is used for titles and headlines (what its all about)
2. Text is used for menus (where to go)
3. Text is used for navigation (how to get there)
4. Text is used for content (what you see when you get there)

Type Face and Fonts:

A typeface is a family of graphics characters that usually includes many type sizes and styles. Letters, numbers and other characters can be displayed in a variety of sizes and styles. The overall design style for a set of characters is called a type face. Typeface is measured in point sizes, where one point is approximately 1/72 of an inch. It is a measure of the height of the metal blocks containing letters. A font is a collection of a single size and style belonging to a particular typeface family. Typical font styles are Normal, bold face and Italic. The term font referred to a set of cast metal character forms in a particular size and format, such as 10-point courier italic. Other style attributes such as underlining, outlining, and

striking of character can also be added. Type sizes are usually expressed in points like one point is 0.138 inch or about 1/72 of an inch. The font's size is the distance from the top of the capital letters to the bottom of the descenders in letters as g and y. Helvetica, Times, Courier are examples of typefaces. It computer world, the term font is commonly used when typeface or face would be more correct. The font's size does not exactly describe the height or width of its characters.

bitmapped font A simple method for representing the character shapes in a particular typeface is to use rectangular grid patterns. The set of characters are then referred to as a bitmap font.

outline font A flexible scheme is to describe character shapes using straight-line and curve sections. In this case, the set of character is called an out line font.

Design Issues:

Computer screens provide a very small workspace for developing complex ideas. Sometimes we required to deliver high-impact or concise text messages on the computer screen in as condensed a form as possible. From a design, user choice of font size and the number of headlines he/she places on a particular screen must be related to both to the complexity of that message and to its venue. If users are creating presentation slides for
any specific purpose ,the text will be keyed to a presentation where the text accents the main message. In this case, use bulleted points in large fonts and few words with lots of white space.

Bitmap, True Type, Post script:

Bit is the simplest element in the digital world which is an electronic digit called binary digit. A map is a two dimensional matrix of these bits. So a Bitmap means a simple matrix of the tiny dots that form an image and are displayed on a computer screen or printed through printer. Bitmap is a matrix of the individual pixels that form an image. Bit-Mapped Font in computer science is a set of characters in a particular size and style, in which each character is described as a unique bit map (pattern of dots). Macintosh screen fonts are examples of bit-mapped fonts. One dimensional matrix (1-bit depth) is used to display monochrome images. In Bitmap each bit is most commonly set to black or white. The picture elements(Pel or pixel) can be either in the 1-bit or more bits which can be represented varying shades or colors which shown below:

- 4 bits for 16 colors
- 8 bits for 256 colors
- 15 bits for 32768 colors
- 16 bits for 65536
- 24 bits for 16772216

Binary combination for describing a Color:

Bit Depth	Number of Colors possible	Available Binary combination for describing a Colour
1 bit	2	0,1
2 bit	4	00, 01, 10, 11
4 bit	16	0000, 0001,0010,0100,0111,0110,0111,1000,1001,1010, 1011,1100,1101,1110,1111

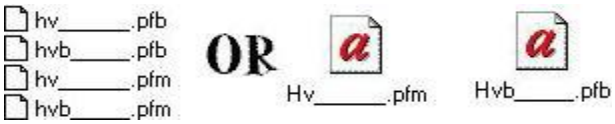
True Type is an outline font methodology developed jointly by Apple and Microsoft companies in May 1989. It is the better and faster quadratic curves outline font methodology. As a means of displaying type on screen as well as print nicely at any size to a laser printer. In addition to print smooth characters on printers, True Type would draw characters to a low-resolution (72 dpi or 96 dpi) monitors. Today, True Type fonts ship with the Windows and Macintosh computers. True Type font allows text to be drawn at any size on your computer screen without jaggies. To provide the quality of hand-crafted bitmapped fonts for smaller sizes ,True Type font foundries often provide hints to control which pixel sin a character are turned on or off at low resolution and size. These are called Enhanced Screen Quality (ESQ) True Type fonts.

PostScript Font in computer science is a font defined in terms of the PostScript page-description language rules and intended to be printed on a PostScript-compatible printer. Post Script system was invented by Adobe Company which is the global leader in digital marketing and digital media solutions. PostScript fonts are distinguished from bit-mapped fonts by their smoothness, detail, and faithfulness to standards of quality established in the typographic industry. Fonts that appear on the screen—for example, as bit-mapped characters in a graphical user interface—are called screen fonts. When a

document displayed in a screen font is sent to a PostScript printer, the printer uses the PostScript version if the font exists. If the font doesn't exist but a version is installed on the computer, that font is downloaded. If there is no PostScript font installed in the printer or the computer, the bit-mapped font is translated into PostScript and the printer prints text using the bit-mapped font. Like True Type font Post Script outline allows text to be drawn at any size on your computer screen without jaggies.

Post Script (ATM) means Post Script Adobe Type Manager. The difference between the two is that Post Script is more accurate and more powerful, while True Type is simpler. For scaling fonts on-screen or for outputting to non-PostScript printers, Adobe Type Manager (ATM) must be installed on user computer. Old versions of Windows operating system like Windows 2000 do not need Post script Adobe Type Manager but advance version Windows operating systems need ATM.

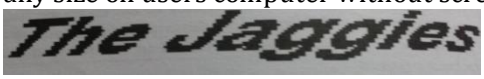
There will be at least two parts to this font: an **Outline** font (.pfb file) and a **Font Metrics** (.pfm) file. Both files must be submitted. The Postscript font files will look like this:



Most PostScript typeface files still follow the DOS 8.3 naming conventions, the actual typeface file names could be highly abbreviated and the file names may have little resemblance to the actual typeface name. Without ATM (Adobe Type Manager), finding the correct files for a specific PostScript typeface might be a complex.

The Jaggies:

The Jaggies are the ragged edges around the boundary of an object or text character displayed on the computer screen. Jaggies are avoided by anti-aliasing the edges of the text characters by making them seem smother to the eye. The True Type and Post Script outline fonts are allowing text to be drawn at any size on users computer without screen.



In bitmap graphics objects or graphics are printed at different sizes. At object's original size the graphics looks relatively smooth but at larger sizes it takes on a jagged appearance.

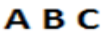


Figure A: Normal Text without jaggies

Figure B: Scaled Text looks with jaggies

Fontographer:

Fontographer is a powerful font editing and designing program or tool which is supplied by Fontlab ,Ltd. and located at www.fontlab.com. It is a specialized graphics editor designed for both Windows platform and Macintosh platform. It freehand drawing tool to create professional and precise inline and outline drawings of calligraphic and script characters. It allows users to create their own custom fonts using this font editing and designing tool. The users can use it to develop Post Script, True Type and bitmapped fonts for different platforms like Windows, Macintosh, DOS, Sun workstations etc. Designers can also modify existing typeface, incorporate PostScript artwork, automatically trace scanned images and create designs from scratch.

Features of Fontographer Tool:

1. It includes free hand drawing tool to create general and professional inline/outline drawings.
2. It supports to use mouse or alternative input methods like drawing boards, pressure-sensitive pen system.
3. It allows creations of multiple font designs from two existing typefaces.
4. It allows modifying the font of an entire typeface.

Font Monger:

Font Monger is a powerful font editing and designing program or tool which is widely used to make a new and advance font type. It can also edit the existing typefaces to design variations. It is specially used for Macintosh computers. It converts Macintosh PC fonts to another platform. It allows editing and expanding of type library by generating a new font composed of small caps, oblique, subscript, superscript characters. To create new fonts or to manipulate the existing ones, it also includes freehand drawing tools, a scissors tool, and a gizmo tool that rotates slants and skews character outlines.

Font Chameleon:

Font Chameleon is another powerful font editing and designing program or tool which is very useful for the both Macintosh and Microsoft Windows platforms. Font Chameleon is created by the same team that brought us Font Monger and Letraset Font Studio which was an extremely powerful font manipulation program. Its power resulted from taking direct control of outline editing away from the user. It has features to build millions of different fonts from a single master font outline. Using a new way of representing fonts, where each character was defined as a set of "difference descriptors" from a generic outline, Ares created close approximations of 150 well-known fonts. Chameleon consists of 16 fonts based on 3 completely different designs. Different but specially designed to complement each other. Together they form a well-balanced design kit suitable for many different projects, e.g. invites, menu's, magazines, brochures, packaging, etc. Chameleon comes in three styles: 2 outline versions and a basic (solid) version. To combine Chameleon with Chameleon Fill, you will need an application that allows you to stack text frames. Once you start layering different fills, like a true chameleon, you can change colors and patterns. Simply place several layers on top of each other, choose from 7 fills to determine your pattern and assign a color to the fill. Always place one of the outline versions of Chameleon on the top layer. So this could save 95% of fonts' disk space. A simple use of Font Chameleon's blend feature would be to interpolate between Helvetica Regular and Helvetica Bold.

Font Chameleon fonts have unparalleled flexibility. Design parameters of a font are changed using slider bars which universally modify all the characters in any of the fonts in the font descriptor list. Slider bars control the weight, length of ascenders, depth of descenders, width (condense/extend amount), cap height, number height, x-height, slant and tracking. Even two different fonts can be blended together to create a new font, which leads to potentially millions of useful font variations.

The Font Chameleon flexible fonts:

- Ares Serif 1 (Similar to Aachen Bold): Aachen Bold.
- Ares Serif 16 (Similar to Bookman): Bookman Light, Bookman Light Italic, Bookman Medium, Bookman Medium Italic, Bookman Demi, Bookman Demi Italic, Bookman Bold and Bookman Bold Italic.
- Bodoni: Bodoni, Bodoni Bold and Bodoni Poster.
- Caslon: Caslon Book and Caslon Black.
- Century: Century Condensed Light, Century Condensed Book, Century Condensed Book Italic, Century Condensed Bold, Century Condensed Bold Italic, Century Light, Century Book, Century Book Italic, Century Bold, Century Bold Italic, Century Ultra, Century Condensed Ultra.
- Courier: Courier, Courier Oblique, Courier Bold and Courier Bold Oblique.
- Cooper Black: Cooper Black.
- Franklin Gothic: Franklin Gothic Extra Condensed, Franklin Gothic Book, Franklin Gothic Book Oblique, Franklin Gothic Demi, Franklin Gothic Demi Oblique, Franklin Gothic 2 Roman, Franklin Gothic Heavy and Franklin Gothic Heavy Oblique.
- Ares Sans 46 (Similar to Frutiger): Frutiger Light, Frutiger Light Italic, Frutiger, Frutiger Italic, Frutiger Bold, Frutiger Bold Italic, Frutiger Black, Frutiger Black Italic and Frutiger Ultra Black.
- Futura: Futura Condensed Bold, Futura Condensed Bold Oblique, Futura Condensed, Futura Condensed Oblique, Futura Condensed Light, Futura Condensed Light Oblique, Futura Condensed Extra, Bold, Futura Condensed Extra Bold Oblique, Futura Light, Futura Light Oblique, Futura Book, Futura Book Oblique, Futura, Futura Oblique, Futura Heavy, Futura Heavy Oblique, Futura Bold, Futura Bold Oblique, Futura Extra Bold and Futura Extra Bold Oblique.
- Garamond: Garamond Condensed Bold, Garamond Condensed Book, Garamond Condensed Light, Garamond Condensed Ultra, Garamond Light, Garamond Light Italic, Garamond Book, Garamond Book Italic, Garamond Bold, Garamond Bold Italic, Garamond Ultra and Garamond Ultra Italic.
- Gothic 13: Gothic 13.
- Goudy Old Style: Goudy Old Style and Goudy Old Style Extra Bold.

- Ares Sans 60 (Similar to Helvetica Neue): Helvetica Neue Ultra Light, Helvetica Neue Ultra Light Italic, Helvetica Neue Thin, Helvetica Neue Thin Italic, Helvetica Neue Light, Helvetica Neue Light Italic, Helvetica Neue Roman, Helvetica Neue Italic, Helvetica Neue Medium, Helvetica Neue Medium Italic, Helvetica Neue Bold, Helvetica Neue Bold Italic, Helvetica Neue Heavy, Helvetica Neue Heavy Italic, Helvetica Neue Black and Helvetica Neue Black Italic.
- Walbaum: Walbaum, Walbaum Book, Walbaum Bold, Walbaum Book Medium and Walbaum Book Bold.

etc.

Icons & Symbols:

Symbols are concentrated text in the form of stand-alone graphic constructs. Symbols are also called special type of characters. Symbols convey meaningful messages in any type of documents. Windows and Macintosh both type of operating environments contain several symbols and group of symbols. Icons are smaller pictures or graphical symbols that are used to represent any file or program or command. Icons are symbolic representations of objects and processes common to the graphical user interfaces (GUI) of many computer operating systems. Pictures, icons, moving images and sounds are the most easily recalled and remembered by viewers and users. With multimedia system user has the power to blend both text and icons as well as colors, sounds, images and motion videos to enhance the overall impact and values of the messages. Some of the software are also used to create the graphics symbols like HyperCard which was first introduced in 1987.

Animation Text and 3D effects:

Animation is the simulation movement created by displaying a series of text characters or pictures one after another. With the help of animation any event can be explained more clear and concise. Powerful applications like Xaos Tools' Type Caster provides user to create Three Dimensional (3D) text using True Type and Type 1 Adobe fonts. User can use Illustrator or Free Hand Encapsulated Post Script (EPS) outline files to create still images in 3D and create QuickTime movies with broadcasting quality rendering.

Logo Motion:

Logo Motion is a Graphic Design program provides students with traditional design training in print and web design in addition to learning motion and digital graphic design. Training in this challenging program prepares students for careers as motion graphic designers in broadcast, film, web, advertising and other industries.

ASCII Standard:

ASCII stands for American Standard Code for Information Interchange. It is the standard 7-bit character coding system most commonly used by computer systems in the United States and abroad. ASCII assigns a number or value to 128 (0 to 127) characters including lower and uppercase letters, punctuation marks, Arabic numbers and mathematical symbols. Also included are 32 control characters used for device control messages like carriage return, line feed, tab and form feed.

ASCII code structure:

SN	Characters	ASCII
1.	A-Z	65 to 90
2.	a-z	97 to 122
3.	0-9	48 to 57
4.	Enter Key	13
5.	Space Key	32
6.	Escape Key	27

ASCII code numbers always represent a letter or symbol of the English alphabet, so that a computer or printer can work with the number that represents the letter. ASCII was invented and standardized for analog tele-type communication early in the age of bits and bytes. The capabilities of the technology now moved for the advanced I/O devices to process or produced the result on the display screen.

Extended Character Set is most commonly filled with American National Standards Institute (ANSI) standard characters, including often-used special symbols like **∞ or ¢** and international alphabet character or diacritics

like **ä** or **ň.** These characters set are also called ISO-Latin-1 character set. These are also used HTML text programming for the web pages.

2. Sound: Sound is a meaningful speech in any language. It can provide the listeners with the divine

experience of enjoying music or set the ambience of a mood setting background. Sound is produced by vibrations that compress air or other medium. These sound waves reach the ear and the vibrations are perceived as sound. It is also called Audio. It is the most sensuous element of multimedia. It can be music, speech or any other sound. Computers and digital technology have changed the quality of audio system. Digital music is used to produce special audio and sound effects. The audio medium is normally combined with animation medium, which increases the interactivity with the user. Sound pressure levels (loudness or volume) are measured in decibels (dB).

Sound, like visual elements, must be recorded and formatted so the computer can understand and use it in presentations. There are two basic properties of sound: Pitch (related with frequency of sound wave which is measured in Hertz where 1HZ=1 cycle/second) and Intensity (related with amplitude of sound wave which is measured on logarithmic scale). Two common types of audio format are Waveform (WAV) and Musical Instrument Digital Interface (MIDI). WAV files store actual sounds, much as music CDs and tapes do. WAV files can be large and may require compression. MIDI files do not store the actual sounds, but rather instructions that enable devices called synthesizers to reproduce the sounds or music. MIDI files are much smaller than WAV files, but the quality of the sound reproduction is not nearly as good.

i) Waveform

Sound is produced by the vibration of matter. During the vibration pressure variation are created in the air surrounding it. The pattern of the oscillation is called a waveform.

(ii) Frequency

The frequency of the sound is the reciprocal value of the period. It represents the number of period s in a second and it is measured in Hertz (Hz) or cycles per second.

(iii) Amplitude

A sound also has amplitude. The amplitude of a sound is a measure of the displacement of the air pressure wave from its, or quiescent state.

What are the types of sound objects that can be used in multimedia production?

There are four types of sound objects that can be used in multimedia production:

- Waveform audio
- MIDI sound tracks
- Compact disc (CD) audio
- MP3 files

Multimedia System Sounds:

In Windows, multimedia system sounds are available in the form of WAV files and they reside inside the Windows\medias subdirectory. Available system event sounds include start.wav, Chimes.wav, chord.wav, ding.wav, logoff.wav, notify.wav, recycle.wav, tada.wav, Microsoftsound.wav. After installing Microsoft Office package other sounds are also available in the computer systems that are: applause.wav, camera.wav, carbarake.wav, cashreg.wav, clap.wav, driveby.wav, dumbroll.wav, explode.wav, glass.wav, gunshot.wav, laser.wav, projector.wav, ricochet.wav, type.wav and whoosh.wav etc. Must sound used in a multimedia production is either digitally recorded audio or Musical Instrument Digital Interface (MIDI) music. Newly created sound files can be added and installed in a manner that they play when system events occur.

MIDI:

Musical Instrument Digital Interface (MIDI) is the interface between electronic musical instruments and computers is a small piece of equipment that plugs directly into the computer's serial port and allows the transmission of music signal. MIDI is considered to be the most compact interface that allows full-scale output. Musical Instrument Digital Interface is the quickest, easiest and the most flexible tools for composing users own original project. MIDI is a communications standard developed in the early 1980s for electronic musical instruments and computers. It was first announced in 1982 which actually on an instrument. The file extension of midi format is ".midi" or ".mid". MIDI Instruments can be synthesized are identified by a general MIDI numbering system that ranges from 0 to 127. Some MIDI devices offset the numbers by using 1 to 128. Most of the software have a switch to accommodate these devices. It is easy to edit MIDI data so, many fine adjustments can be made to the music. It is the best way to create original music for multimedia project.

Musical Instrument **D**igital **I**nterface is a 'language' for sending messages between multiple electronic devices. MIDI devices like keyboards, music synthesizers, and drum machines can 'speak' to and play with each other.

The soundcard installed in your computer can also respond to MIDI messages. MIDI can be thought of as the piano roll in the most amazing player piano ever invented. A MIDI file contains a set of instructions for how the music should be played and what instrument should play the sound. The MIDI file does not contain the actual sounds, it only contains instructions for what sound should be played, how it should be played and when it should be played. When you want to hear the contents of the MIDI commands (the "MIDI sequence") the MIDI file must send its commands to some kind of electronic sound generator, which then makes the sounds following the MIDI sequence's commands.

A MIDI interface has two different components:

- Hardware
- Data format

Hardware connects the equipment. It specifies the physical connection between musical instruments, stimulate that a port MIDI port is built into an instrument, specifies a MIDI cable and deals with electronic signals t that are sent over the cable.
Data format encodes the information traveling through the hardware MIDI data format includes an instrument –connected data format. The encoding includes, besides the instrument specification, the notion of the beginning and end of a note, basic frequency and sound volume; MIDI data allow an encoding of about 10 octaves, which corresponds to 128 notes.

Components of Midi systems:
Synthesizer: A sound generator. A good synthesizer often has a microprocessor, keyboard, control panel and memory etc.
Sequencer: A stand-alone unit or a software program for a computer. It is used to be a storage server for MIDI data. It is a software music editor on the computer which has one or more MIDI INs and MIDI OUTs.
Track: It is used in sequencer to organize the recordings. Tracks can be turned on or off on the recording or playing back.
Channel: These are used to separate information in a MIDI system. These are 16 MIDI channels in one cable. Channel numbers are coded into each MIDI message.
Timber: The quality of sound like flute sound, cello sound etc.
Pitch: Musical note that the instrument plays.
Voice: The portion of the synthesizer that produces sound. Synthesizers can have 12,20,24,36 voices. Each voice works independently and simultaneously to produce sounds of different timber and pitch.
Patch: The control setting that defines a particular timbre.
Advantages of MIDI:

- MIDI files are much more compact.
- The size of a MIDI file is completely independent of playback quality. MIDI files are 200 to 1000 times smaller than CD quality digital audio files.
- MIDI files may sound better than digital audio files if the MIDI sound source using that is of high quality.
- Length of a MIDI file can be changed without changing the pitch of the music or degrading the audio quality.
- MIDI files embedded in web pages load and play more quickly than their digital equivalent.
- MIDI data is completely editable. A particular instrument can be removed from the song and/or a particular instrument can be changed by another just by selecting it.
- MIDI files may sound better than digital audio files if the MIDI sound source you are using his of high quality.

Disadvantages of MIDI:

- MIDI data is not sound. It is score, so playback will be accurate only if the MIDI playback device is identical to the device used for production.
- MIDI cannot be used to playback the spoken dialogue.
- MIDI playback will be accurate only if the MIDI playback device is identical to the device used for production.
- Working with MIDI data requires familiarity with musical scores, keyboards, notation, and audio production.
- MIDI data is device dependent (the sounds produced by MIDI music files depend on the particular MIDI device used for playback).

Digital Audio:

Digital Audio sound is sampled sound. Digital audio includes sound or voice stored in CDs as well as

stored in any desktop computer or laptops. Every n^{th} fraction of a second, a sample of sound is taken and stored as digital information in bits and bytes. How often the samples are taken is the "sampling rate" and the amount of information stored about each sample is "sample size". As the sampling rate goes high, the resolution and quantity of the captured sound is increased. An audio signal is represented in digital memory with a binary code that stores a massive amount of numbers that are used to represent a signal. An ADC (Analog to Digital Converter) is a computer chip that is used to convert an analog signal into digital information. This process is called sampling and has changed the world of sound in a dramatic fashion. Digital audio data is the actual or presentation of a sound, stored in the form of thousands of individual Numbers. A Digital Audio recording is a very faithful, high fidelity record* of what happened at a certain time, in the real world which not a sequence of commands telling an electronic sound generator how to make sounds (as in MIDI).

The following three sampling frequencies are most often used in multimedia.
CD Quality : 44.1 kHz.
Stereo : 22.05 kHz.
Mono : 11.025 kHz.
The three sampling frequency most often used in multimedia our CD-quality 44.1 KHz, 22.05 KHz and 11.025 KHz. Sample sizes are 8 bits or 16 bits. the larger the sample size, the better the data describes the record sound. There are many more types of sound objects which are used in multimedia production. Waveform audio, Midi sound tracks, Compact disc (CD) audio and MP3 files.

Audio File Formats:

A sound file's format is a methodology for organizing the digitized sound's data bits and bytes into a data file.

Audio File Formats

Extension	*MIME Type*	*Platform*	*Use*
aif	Audio/x-aiff	Mac, SGI	Audio
aifc	Audio/x-aiff	Mac, SGI	Audio (compressed)
AIFF	Audio/x-aiff	Mac, SGI	Audio
aiff	Audio/x-aiff	Mac, SGI	Audio
au	Audio/basic	Sun, NeXT	Audio
mov	Video/Quick Time	Mac, Win	Quick Time video
mpe	Video/mpeg	All	MPEG video
mpeg	Video/mpeg	All	MPEG video
mpg	Video/mpeg	All	MPEG video
qt	Video/Quick Time	Mac, Win	Quick Time video
ra, ram	Audio/x-pn-realaudio	All	RealAudio Sound
snd	Audio/basic	Sun, NeXT	ULAW Audio Data
vox	Audio/	All	Vox Ware Voice
wav	Audio/x-wav	Win	VAV Audio

Digital Audio Advantages:

- In general, the most important advantage of digital audio its is consistent playback quality.
- Digital audio is used far more frequently than MIDI data for multimedia sound tracks.
- The preparation and programming required for creating digital audio do not demand knowledge of music theory.
- Digital audio data is not device dependent (digital audio produces sounds that are more or less identical regradless of the playback system).
- A wider selection of applications software and systems support for digital audio is available for both, the Macintoch and Windows platforms.
- Digital audio can handle spoken dialogue.

Digital Audio Disadvantages:

- Digital audio won't work if you don't have enough RAM, hard disk space, CPU processing power or bandwidth to process it.
- Digital audio files are bigger than MIDI files.

MIDI vs. Digital Audio:

The process of creating MIDI is quite different from digitizing existing audio. It allows music and sound synthesizers from different manufacturers to communicate with each other by sending messages along cables connected to the devices. MIDI provides a protocol for passing details descriptions of a musical score like notes, sequences of notes and instrument which will play these notes.

Digital Audio is a recording. Digitized audio is thought as analogous to a bitmapped graphic image both use sampling of original analog medium to create a digital copy, while MIDI is thought analogous to structured or vector graphics. A MIDI keyboard is also useful for simplifying the creation of musical scores.

CD-quality audio is digitized by sampling the analog audio wave 44.1 thousand times per second and each sample is assigned amplitude encoded into a 16-bit number. Stereo audio requires double the storage, so 1 second of CD-quality stereo audio takes: 44,100 * 16 * 2 = 172KB. That comes out to about 10MB per minute, meaning that most songs require between 20MB (The Ramones) and 170MB (Iron Butterfly). Various compression techniques have arisen that are able to significantly reduce the size of audio files without seriously reducing the quality. One of the most popular at the moment is the MP3 format (MPEG III) that can achieve a variable compression ratio of between 5 and 20 (the most common ratio is 7, so a 4 minute song would require only 5.7MB rather than the 40MB needed by an uncompressed format. Music compression is more complicated than the algorithms used in images. Typically, the compression algorithm removes parts of the audio signal that aren't audible to the human ear, or that don't drastically change the shape (timbre) of the sound. In this way, audio compression is a lossy type of compression since the original can't be perfectly reconstituted from the compressed form.

SN	MIDI AUDIO	DIGITAL AUDIO
1.	A MIDI file is software for representing musical information in a digital format.	A digital audio refers to the reproduction and transmission of sound stored in a digital format.
2.	Musical Instrument Digital Interface is a communications standard.	Digital Audio is the actual representation of musical data or sound.
3.	MIDI data is device dependent.	Digital Audio data is device independent.
4.	MIDI is the least reliable.	Digital Audio data consistent playback quality and more reliable.
5.	MIDI used multimedia sound tracks.	Digital audio used far more frequently than MIDI.
6.	MIDI files are much more compact than digital audio.	Digital audio files are not more compact.
7.	MIDI files contain less memory space.	Digital audio files contain more memory space than MIDI files.
8.	MIDI does not contain a recording of sound.	Digital audio contains a recording of sound.

3. Pictures: A graphics or picture is a digital representation of non-text information s such as drawing, charts, or photographs. Presenting information using text and image media give clearer than core textual matter. Pictures help in explaining concepts through illustrations and charts. The information presented through text and picture media retain for a long time in the memory. Images or pictures created in different applications can be stored in a computer as Tagged Image File (TIF), Bitmap (BMP), Graphics Interchange Format (GIF), Windows Metafile Format (WMF), Joint Photographic Expert Group (JPEG/JPG) etc. file formats.

The larger, sharper, and more colorful an image is, the harder it is to present and manipulate on a computer screen. Photographs, drawings, and other still images must be changed into a format that the computer can manipulate and display. Such formats include bit-mapped graphics and vector graphics.

Bit-mapped graphics store, manipulate, and represent images as rows and columns of tiny dots. In a bit-mapped graphic, each dot has a precise location described by its row and column, much like each house in a city has a precise address. Some of the most common bit-mapped graphics formats are called Graphical Interchange Format (GIF), Tagged Image File Format (TIFF), and Windows Bitmap (BMP).

Vector graphics use mathematical formulas to recreate the original image. In a vector graphic, the dots are not defined by a row-and-column address; rather they are defined by their spatial relationships to one another. Because their dot components are not restricted to a particular row and column, vector graphics can reproduce images more easily, and they generally look better on most video screens and

printers. Common vector graphics formats are Encapsulated Postscript (EPS), Windows Metafile Format (WMF), Hewlett-Packard Graphics Language (HPGL), and Macintosh graphics file format (PICT).

Obtaining, formatting, and editing video elements require special computer components and programs. Video files can be quite large, so they are usually reduced in size using compression, a technique that identifies a recurring set of information, such as one hundred black dots in a row, and replaces it with a single piece of information to save space in the computer's storage systems. Common video compression formats are Audio Video Interleave (AVI), Quicktime, and Motion Picture Experts Group (MPEG or MPEG2). These formats can shrink video files by as much as 95 percent, but they introduce varying degrees of fuzziness in the images.

Images or pictures can be generated by computers in the two ways: as bitmaps (paint graphics) and as vector-drawn graphics (plain drawn graphics).Bitmaps are used for photo realistic images and for complex drawing ,requiring fine details. Vector-drawn objects are used for lines, boxes, circles, polygons and other graphics shapes that can be mathematically expressed in angles, coordinates and distances. Both type of images are stored in various file formats and can be translated from one application to another or from one computer platform to another.

Bitmap software:

Painting softwares are bitmap softwares. The abilities and features of paint programs for both the Macintosh and Microsoft windows, range from simple to complex. Some of the commonly used bitmap softwares are:

Macromedia's Director: It includes powerful image editor that provides advanced tools such as "online-skinning" and image filtering.

Adobe's Photoshop: It is an advanced image editor which supports image filtering using common plug-ins.

Fractal DesignPainter: It provides astoundingly realistic classical art effects using a complete palette of brushes and digital tools. It can work with millions of colors, depending upon the system's video card and monitor hardware.

Image File Formats

Format	*Extension*
MS Windows DIB	BMP, DIB, and RLE
MS RLE DIB	DIB
MS Palette	PAL
MS RIFF DIB	RDI
Computer Graphics Metafile	CGM
Micrografx Designer/Draw	DRW
AutoCAD Format 2-D	DXF
Encapsulated PostScript	EPS
CompuServe GIF	GIF
HPGraphics Language	HGL
JPEG	JPG
PC PaintBrush	PCX
Apple Macintosh PICT/Lotus 123 Graphics	PIC
AutoCAD Import	PLT
TrueVision TGA	TGA
TIFF	TIF
Windows Metafile	WMF
DrawPerfect	WPG

4. Video: Video refers to pictures in motion. The video medium presents the moving images of real events. Both sound and picture Medias are used for presenting information in the video. It is the excellent way to convey messages to the user in a limited time. The information presented with the video medium retain for a long time in the memory of people.

5.Animation: Animation refers to simulation of movement created by displaying a series of images one after another. The animation medium presents the sequence of still images of artwork at a rapid speed that looks like the image is moving. It is especially used to present information that cannot be explained with a video in a short interval of time. Now a day animations are mostly used to explain how anything did happen. Cartoons such as Pokemon, Tom and Jerry, Power Puff Girl, Donald Duch, Motu aur Patlu etc. are examples of computer animations.

Professional Sound Standard:

Red Book Standard:

THE standard for compact disc masters is called RedBook. RedBook audio is also referred to as CD-DA (Compact Disc-Digital Audio). Introduced by Sony and Philips in 1980. The RedBook standard was simply designed to be a universal medium for distributing digitized music. Red Book is the audio standard for compact discs that ensures that all of the music following these guidelines will play in the majority of CD players. It got its name from a series of books called **Rainbow Books** and as the name states, is the red colored book that focuses on CD- Digital Audio. A RedBook disc is divided into three areas: Lead In, Program, and Lead Out. Every track's location is recorded into the disc's TOC (Table of Contents) which is stored in the Lead In area of every disc. The Red Book consists of technical specifications for CD and CD-ROM and includes some of these basic guidelines:

- Maximum duration is 74 minutes
- Each track must be a minimum of 4 seconds
- Maximum of 99 tracks
- 99 maximum number of index points
- ISRC encoding

There are some other areas that define bit rate and error correction, but are usually of no concern when sent into a studio that is associated with mastering audio.

COLOR THEOREY:

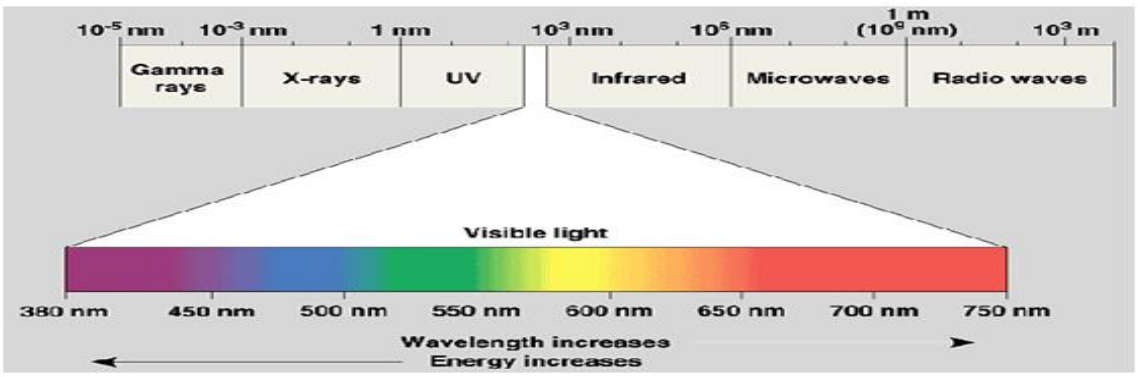
Color is a vital component of multimedia. Management of color is both a subjective and a technical exercise. Selecting the right colors and combination of colors for the any kind of project makes the project perfect. The technical description of a color may be expressed in known physical values like humans (where perceive colors with wavelengths ranging from 400 nm (nanometers) to 600 nm on the electromagnetic spectrum and) and several methods and models describe color space using mathematics and values. Color is the frequency of light wave within the narrow band of the electromagnetic spectrum to which the human eye responds. The letters of the mnemonics :ROYGBIV (color of rainbow) are the ascending frequencies of the visible light spectrum that stand as Red, Orange, Yellow, Green , Blue, Indigo and violet.

Color Model is a method for explaining the properties or behavior of color with in some particular context. It is an orderly system for creating a whole range of colors from a small set of Primary Colors. Perception of color depends upon the physics of light and its interaction with the physical materials and also on the interpretation of the phenomena by human –eye-brain visual system. A color model is a specification of a 3D color coordinate system and visible subset in the coordinate system within which all colors in a particular gamut lie. The purpose of a color model is to allow convenient specification of colors within some color gamut. Some widely used color models are:

- RGB Color Model
- YIQ Color Model
- CMY Color Model
- HSV Color Model
- HLS Color Model

Electromagnetic Spectrum:

Perception of color depends on the physics of light and its interaction with physical materials and on the interpretation of the phenomena by human eye-brain visual system. A"scientific" system of color measurement was devised in the 1931 was the CIE color system. These color numbers can be measured by instruments called "colorimeters" (as opposed to "densitometers"). Human visual system interprets electromagnetic energy having wavelength between approximately 400 to 700 nanometers.



CIE CHROMATICITY DIAGRAM:

Three standard primaries were defined in 1931 by the by the International commission on Illumination. This company referred to as the CIE (Commission Internationale de l' Eclairage). These three standard primaries are imaginary colors. They are defined mathematically with positive color-matching functions that specify the amount of each primary needed to describe any spectral color. This provides an international standard definition for all colors. The CIE primaries eliminate negative-value color matching and other problems associated with selecting a set of real primaries called X,Y,Z to replace red ,green and blue in this matching process. When we plot a normalized amounts **x** & **y** for colors in the visible spectrum , we obtain the tongue-shaped curve called CIE chromaticity diagram. The points along the curve are the pure colors in the electromagnetic spectrum, labeled according to wavelength in nanometers from the red –end to the violet and of the spectrum. Interior points represent all the possible visible color combinations. The famous CIE "chromaticity diagram" illustrates some relationships between colors in this "color space".

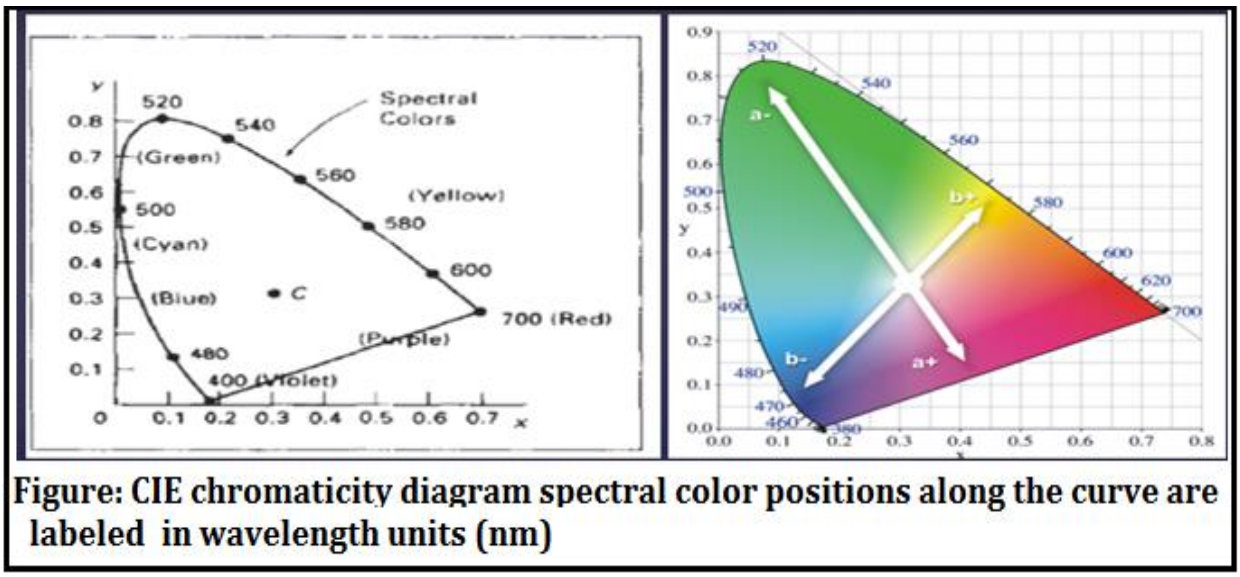


Figure: CIE chromaticity diagram spectral color positions along the curve are labeled in wavelength units (nm)

The chromaticity diagram is useful for following purposes:

- Comparing color gamuts for different sets of primaries.
- Identifying complementary colors.
- Determining dominant wavelength and purity of a given color.

The RGB COLOR MODEL:

The RGB (Red, Green and Blue) color model is the hardware –oriented color model. The RGB color model is used in light emitting devices like Color CRT monitors and color raster graphics that employs a Cartesian coordinate system. This RGB color system uses three color primaries – Red, Green and Blue and these three RGB primaries are additive primaries where individual contributions of each primary are added together to yield the resultant color. It is an additive color model in which red, green, and blue light are added together in various ways to reproduce a broad array of colors. The name of the model comes from the initials of the three additive primary colors, red, green, and blue.The main purpose of the RGB color model is for the sensing, representation, and display of images in electronic systems, such as televisions and computers, though it has also been used in conventional photography.

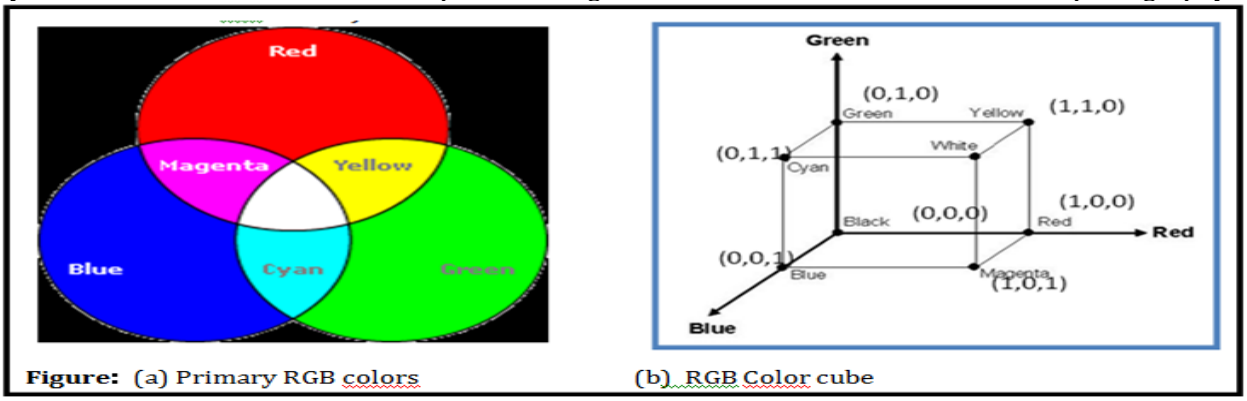


Figure: (a) Primary RGB colors (b) RGB Color cube

We can represent this RGB color model with a unit cube defined on R,G and B axes. The structure for the RGB color cube mentioned below:

- ☞ Origin represents Black.
- ☞ Vertex with coordinate (1,1,1) is white
- ☞ Vertices of the cube on each axes represent the primary colors red, green and blue respectively
- ☞ Remaining vertices represent complementary colors for each of primary colors (Cyan, Magenta and Yellow)

The CMYK COLOR MODEL:

For printing and graphics art industry, CMY is not enough so a fourth primary, K which stands for black, is added.

Conversions between RGB and CMYK are possible, although they require some extra processing. This color model is widely used for printing progress and graphics design. In this system four-color printing uses black ink (K) in addition to the subtractive primaries yellow, magenta, and cyan. Some reasons for Black color addition include:

- CMY Mixture rarely produces pure black
- Text is typically printed in black and includes fine detail.

This system is Cost saving: Unit amount of black ink rather than three unit amounts of CMY.

The YIQ COLOR MODEL:

The RGB color primary system used for standard color television broadcasting which is detected by the requirement to confine the broadcast signal to a 0-6 MHz bandwidth and by the requirement for compatibility with the standard for black and white television. In 1953 AD the National Television System Committee (NTSC) adopted a standard color primary system that is called the YIQ color system. The YIQ color primary system is based on concept from the CIE XYZ system.

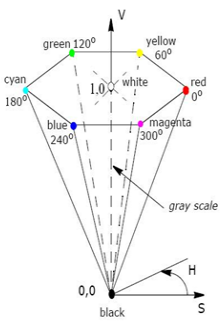
The YIQ color model is also the hardware –oriented color model. This color system is used in U.S. commercial color-TV broadcasting. In the YIQ color model, parameter y was chosen to the brightness or luminance and chromaticity information i.e. hue and purity which is incorporated into the I and Q parameter. The signal for Y occupies the major portion of the available broadcast bandwidth 0 -4 MHz and parameter I contains orange –cyan hue and occupies a bandwidth of approximately 1.5 mhz. Parameter Q occupies green-magenta hue information in a bandwidth of 0.6 MHz. The YIQ color model uses a 3D Cartesian coordinate system with the visible subset being a context polyhedron that maps into the RGB cube.

YUV COLOR MODEL:

YUV color model was developed for broadcast TV (composite NTSC). This is based on luminance and chrominance expressed as the amplitude of a wave and the phase of the wave relative to the some reference. Detail is carried by luminance (black and white).This process can be translated to a number values so that the computer can use a palette or CLUT (colour lookup table) to assign a color to a pixel.

The HSV COLOR MODEL:

This HSV color model is first described by Alvy Ray Smith in 1978. HSV and HLS color models are user-oriented. HSV model uses color descriptions rather than color primaries and improve upon the RGB color model. It is based on the intuitive appeal of artist's tint, shade and tone. It is a useful implementation of a basic subjective color model contains color parameters those are hue (H), Saturation (S) and Value (V). The 3D representation of HSV model is derived from the RGB cube. If we imagine viewing of the cube alone the diagonal from the white vertex to the origin (black), we can see outline of cube as hexagon shape. Hue is represented as an angle about the vertical axis, ranging from 0^0 at red through 360^0 vertices of the hexagon are separated by 60^0 interval. This color system is true color system that produces 16 million colors.



- Red is at 0°
- Yellow at 60°
- Green at 120°
- Cyan at opposite red at H= 180°

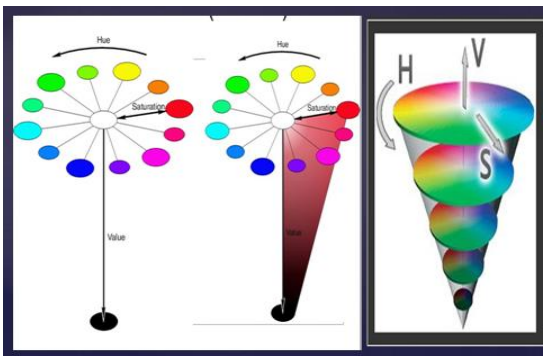


Figure: The HSV hexcone

The HLS COLOR MODEL:

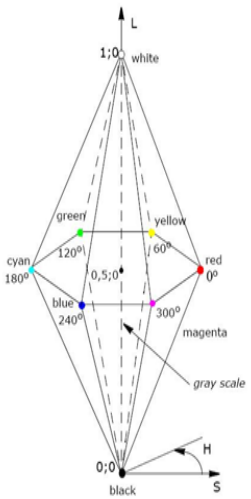
HLS and HSV colors are device independence color models. HSL was described by Alvy Ray Smith and is a 3D representation of color. This HLS color model is also user oriented color model. HSL stands for hue, saturation, and lightness. The HSL color model has distinct advantages over the HSV model, in that the saturation and lightness components span the entire range of values. This model has double hex-cone representation. HSV and HLS are both widely used in computer graphics, particularly as color pickers in image editing software.

This color model uses three color parameters:

Hue (H) : specifies an angle about the vertical axis of a double hex-cone.

Lightness (L): The vertical axis represents lightness.

Saturation (S): distance from the center.



- Red is at H=0° (Some representations have blue at 0°)
- Yellow at 60°
- Green at 120°
- Cyan at 180°
- Complementary colors are 180° apart on the double cone
- At L= 0, Black and White at L=1

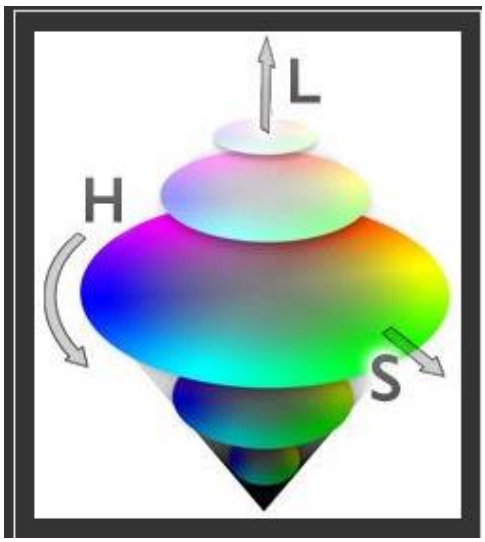


Figure: The HLS double cone.

Platte Management:

Platters are mathematical tables that define the color of a pixel displayed on the screen. On the Macintosh, these tables are called color lookup tables(CLUTs). In windows these color tables are known as palette. The common platters are 1,4,8,16, and 24 bits deep. The color depth and colors availabilities in the platters are shown in the table below :

SN	COLOR DEPTH	COLORS AVAILABLE
1.	1-Bit	Black and White (or any two other colors /mono chrome colors)
2.	4-Bit	16 colors
3.	8-Bit	256 colors (good enough for color images)
4.	16-Bit	Thousands of colors (65,536 excellent for color images)
5.	24-Bit	More than 16 million colors (16,777,216: totally photorealistic) 256x256x256

For 256-color, 8-bit VGA system ,the computer uses a color lookup table or palette to determine which 256 colors out of the millions possible are available to user at any time. The default system colors were statistically selected by Apple and Microsoft engineers to be the colors and shades that are most popular in photographic images. Paint programs provide a palette tool for displaying available colors. Most color pickers and selectors also provide a mechanism for specifying a palette color numerically when precision is required.

Painting Vs Drawing:

The word "painting" normally refers to a "bitmap" image. This is a graphic made up of many tiny colored squares called "bits" which are "mapped" on a background to give the illusion of "continuous tone" shadings, such as those seen in a photograph. These images are also often referred to as "raster" graphics. Professional graphic artists generally use heavy-duty programs such as Adobe Illustrator for "drawing" and Adobe PhotoShop for "painting."

Drawing is a form of visual art that makes use of any number of drawing instruments to mark a two-dimensional medium. Instruments used include graphite pencils, pen and ink, inked brushes, wax color pencils, crayons, charcoal, chalk, pastels, various kinds of erasers, markers, styluses, and various metals (such as silverpoint). An artist who practices or works in drawing may be called a *draftsman* or

draughtsman. With a "drawing" program, on the other hand, one normally creates images by establishing points that are connected by straight or curved lines, resulting in shapes such as a rectangle or an oval. The shapes can then be filled with colors resulting in, say, a red heart or a green shamrock. Many of the cartoon-style "clipart" drawings found on the Web are considered drawings rather than paintings. These drawings are also often referred to as "vector" graphics. "Drawing" Tools are available in Word Processing Program. Users of MS-Word or WordPerfect also have some "drawing" tools.

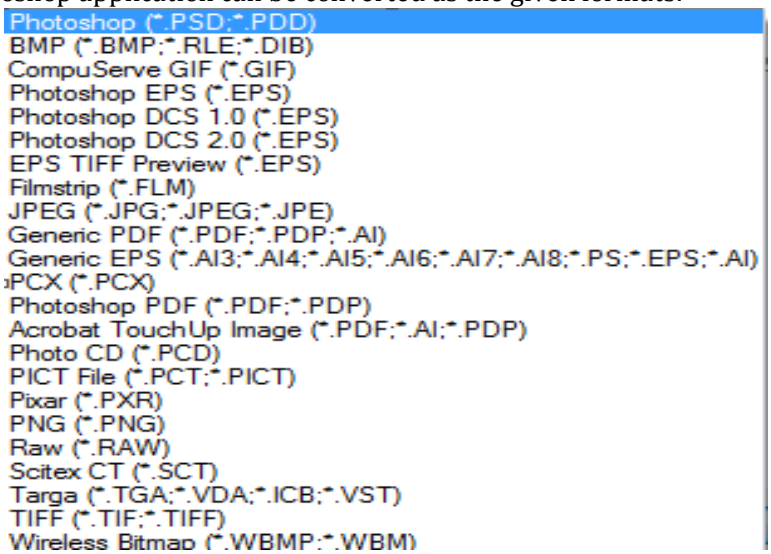
Painting and drawing software applications are also important tools for image creating, editing and designing for multimedia objects. These software applications are sometimes called graphics applications which allow users to change the size of photos, brightness, color, contrast, crop, rotate, flip and compressing the images. Well a painting you have to paint with a paintbrush and paint. Also most paintings are painted on canvas. On the other hand, a drawing you draw with colored pencils or most other art utensils. In a painting, someone uses a brush to smear paint based on oil, water or acrylic compounds onto a surface like canvas, wood, cardboard, a wall.. any flat surface. In a drawing on a computer, someone uses the mouse or a stylus to indicate where certain colors should be displayed on a grid, this grid can me made so fine that the difference between an image of a painting is indistinguishable from a computer drawing.

STILL IMAGES:

Still images are visual representations that do not move. Text is ideal for transmitting information in a highly articulate manner that can be consistently interpreted irrespective of the user. Still images allow the content creator to convey information which can be more freely interpreted by the user. A picture does indeed paint a thousand words but the meaning of the picture will vary from user to user. Still images may be small or larger or even full screen. They may be colored, placed at random on the screen, evenly geometric or oddly shaped. Still images may be a single tree on a wintry hillside or stacked boxes of text or an engineering drawing. Still images are generated by the computer in two ways as Bitmaps or paint graphics and as vector drawn graphics. Bitmaps are used for photo-realistic images and for complex drawing. Vector-drawn objects are used for lines, boxes, circles, polygons and other graphics shapes that can be mathematically expressed in angles, coordinates and distances. Still images may be the most important element of multimedia project or web site.

Photoshop and Illustrator:

Adobe's Photoshop is the professional image-editing standard launched in 1988 by Adobe Corporation. It was originally created as a tool for photographers to edit and manage their photos - and for many people, this remains its primary use. Abobe Photoshop is a very popular program used by digital photographers around the world. Photoshop can be used to take any existing image and give it a professional, polished looked. With its integrated Web tool application, Adobe ImageReady R, Photoshop delivers a comprehensive environment for professional designers and graphics producers to create sophisticated images for print, the Web, wireless devices, and other media. It is the best tool for creating GIF (Graphical Interchange File) and JPEG (Joint Photographic Experts Group) images for the use on the World Wide Web. Borders can be added and pictures tweaked to look better than any digital camera could make possible. Almost anything you can imagine doing to a picture is capable when using Adobe Photoshop. The Photoshop image format is PSD format which is typically in RGB mode and uses the maximum color depth. PSD files contain layers inclusion, resizing, sharpening, hue adjustment and dithering features. The Photoshop also contains features of other file conversion and modification. The file created by Photoshop application can be converted as the given formats:



Moreover, Photoshop provides a consistent work environment with other Adobe applications including Adobe Illustrator®, Adobe InDesign®, Adobe GoLive®, Adobe LiveMotion™, Adobe After Effects®, and Adobe Premiere®. Adobe Photoshop is a "bitmap" image processing and manipulation program. It's ideally suited for creating, modifying and outputting digital images of a photographic nature, which share a common fundamental structure: pixels in a bitmap. Simplified, but primary operations would be:

- Access / acquisition of digital graphics photographic in nature
- Add, subtract, modify, colorize, pixels in the images
- Produce digital files where the whole image is part of a "fixed" pixel structure (the "bitmap")
- Prepare complicated color/BW images for further processing in page layout programs for high resolution printing

Adobe Illustrator is a different program entirely. Illustrator is a vector-based drawing program that allows you to create your own unique graphics. Adobe Illustrator graphics can be used in print, online, in video, and even on your cell phone. Illustrator started its life a little earlier than Photoshop in 1987 and was primarily created for the typesetting and logo areas of graphic design. Illustrator is now seen as a tool for both graphic designers and digital artists to create many different types of digital products.

Illustrator is a vector-based postscript drawing program. It functions by generating curved paths (Bezier curves) connected by modifiable anchor points. These anchors, with their handles are ultimately editable, and never "leave" the structure of the file. A *vector* based drawing program creates the various elements of the image as individual *vector objects* which retain their characteristics and do not become part of a "bitmap".

Photo CD:

As a multimedia tool, the Photo CD system represents a method where high quality, high resolution images can be obtained from conventional 35mm film without the need for a high resolution color transparency scanner. Photo CD technology provides individual radiologists a way to create relatively inexpensive interactive teaching programs on personal computers. For the results achieved, Photo CD represents an extremely low cost alternative to these scanners and data storage devices to store the enormous images. For example, a single uncompressed 2048x3072 24 bit image takes over 18 megabytes of storage space. Using a unique method however, about one hundred 35mm color pictures can fit on a single Photo CD disk (in some circumstances, more than one hundred may fit on a single disk).

The actual Photo CD disk consists of a poly-carbonate base, a 24K gold reflectance layer and an Ultra-violet cured protective coating and looks quite similar to the standard audio CD used in the home. Photo CD Master disks contain each image in 5 different 24 bit resolutions (128x192, 256x384, 512x768, 1024x1536 and 2048x3072). The Photo CD disk is packed in a plastic jewel case with an index print showing small versions of each picture to create a visual table of contents.

Digital Photography:

Digital photography uses an array of electronic photo detectors to capture the image focused by the lens, as opposed to an exposure on photographic film. The captured image is then digitized and stored as a computer file ready for digital processing, viewing, digital publishing or printing. The first recorded attempt at building a digital camera was in 1975 by Steven Sasson, an engineer at Eastman Kodak. The first true digital camera that recorded images as a computerized file was likely the Fuji DS-1P of 1988, which recorded to a 16 MB internal memory card that used a battery to keep the data in memory. The first commercially available digital camera was the 1990 Dycam Model 1; it also sold as the Logitech Fotoman.

Until the advent of such technology, photographs were made by exposing light sensitive photographic film, and used chemical photographic processing to develop and stabilize the image. By contrast, digital photographs can be displayed, printed, stored, manipulated, transmitted, and archived using digital and computer techniques, without chemical processing. Digital photography is one of several forms of digital imaging. Digital images are also created by non-photographic equipment such as computer tomography scanners and radio telescopes. Digital images can also be made by scanning other photographic images.

UNIT: 10 ANIMATION AND VIDEO

1. ANIMATION:

Animation refers to simulation of movement created by displaying a series of images one after another. The animation medium presents the sequence of still images of artwork at a rapid speed that looks like the image is moving. Computer graphics animation is the use of computer graphics equipment where the graphics output presentation dynamically changes in real time. This is often also called real time animation.It is especially used to present information that cannot be explained with a video in a short interval of time. Now a day animations are mostly used to explain how anything did happen. Cartoons such as Pokemon, Tom and Jerry, Power Puff Girl, Donald Duch, Motu aur Patlu etc. are examples of computer animations. Computer graphics animation is the use of computer graphics equipment where the graphics output presentation dynamically changes in real time. This is often also called real time animation.

Animation can also be included in multimedia applications to add motion to images. Animations are particularly useful to simulate real-world situations, such as the flight of a jet airplane. Animation can also enhance existing graphics and video elements adding special effects such as morphing, the blending of one image seamlessly into another. Animation is a technique of building progressive images and running it in a sequence to create an effect of motion. In animation, for a moving sequence, different stationary images are drawn and each of them shows some advancement of motion from the previous one. These images are called frames. These progressively built frames are rapidly moved in front of human eye and this is perceived as the motion. TV/Video plays 30 frames per second. It is the speed with which each frame is replaced by the next one that makes the images appear to blend smoothly into movement.

There are a few different ways to make computer animations. One is 3D animation. One way to create computer animations is to create objects and then render them. This method produces perfect and three dimensional looking animations. Another way to create computer animation is to use standard computer painting tools and to paint single frames and composite them. These can later be either saved as a movie file or output to video. One last method of making computer animations is to use transitions and other special effects like morphing to modify existing images and video.

Baek and Layne (1988) defined animation as "*the process of generating a series of frames containing an object or objects so that each frame appears as an alteration of the previous frame in order to show motion*"

Usage of Animation:

- Artistic purposes
- Storytelling
- Displaying data (scientific visualization)
- Instructional purposes

2. ANIMATION TECHNIQUE:

Jurassic Park, Beauty and the Beast and Toy Story are popular commercial films which are excellent examples of animation and rendering process. The subsequent sections talk about the two popular animation techniques:

- Cel animation
- Computer animation

Cel Animation is the popular animation technique or method of overlaying layers of images and sequencing them into an animation. Cel stands for Clear Celluloid Sheet used for drawing each frame in an animation. Cels were used for drawing each frame, which have been replaced today by layers of images. Cel animation artwork begins with key frames i.e. the first and last frame of an action. The series of frames in between the keyframes are drawn in a process called tweening. Tweening is an action that requires calculating the numbers of frames between keyframes and the path the action takes. For examples: A walking man which may made up of a text title, a background , a left arm, a right arm, legs, shoes, a body and facial features. It is the composite structure that becomes the final photographed frame in an animation movie.

Computer animation programs implement the same logic and concepts as Cel animation using different layers, key frames and tweening techniques. The developer can set his/her own frame rates on the computer but it will depend on the speed and power of display platform and hardware.

Morphing:
Morphing is an effect in which one image changes into another. Morphing applications and modelling tools offering the morphing effect can transition not only between still images but often between moving as well. Morphed images are built at a rate of 8 frames per second, with each transition taking a total of 4 seconds(32 separate images for each transition), and the number of key points are held to a minimum to shorten the rendering time. Some products which offering morphing features are:

- Avid's Elasstic Reality
- Human software's Squizz
- North coast's Photo Morph
- Meta Tool's Digital Morph
- Image ware's Morph Wizard

3. Animation File Formats

SN.	File extension	Format
1.	.dir	Director Format
2.	.fli/.fle	Animator Pro
3.	.max	3D Studio Max
4.	.Pic/.Pics	Supercard and Director
5.	.avi	Windows Audio Video Interleaved Format
6.	.mov	Macintosh Time Based Data Format
7.	.mpeg/.mpg	Motion picture expert group(Motion Video)
8.	.gif	CompuServe (Graphics interchange format)
9.	.der	Shock Wave
10.	.spr/.sprite	Sizzler

4. PRINCIPLE OF ANIMATION:

1. Squash and Stretch
2. Anticipation
3. Staging
4. Straight ahead and pose to pose animation
5. Follow through and overlapping action
6. Slow-out and Slow-in
7. Arcs
8. Secondary Action
9. Timing
10. Exaggeration
11. Solid Drawing
12. Appeal

1. Squash and Stretch:
This action gives the illusion of weight and volume to a character as it moves. Also squash and stretch is useful in animating dialogue and doing facial expressions. How extreme the use of squash and stretch is, depends on what is required in animating the scene. Usually it's broader in a short style of picture and subtler in a feature. It is used in all forms of character animation from a bouncing ball to the body weight of a person walking. This is the most important element you will be required to master and will be used often.

2. Anticipation:
This movement prepares the audience for a major action the character is about to perform, such as, starting to run, jump or change expression. A dancer does not just leap off the floor. A backwards motion occurs before the forward action is executed. The backward motion is the anticipation. A comic effect can be done by not using anticipation after a series of gags that used anticipation. Almost all real action has major or minor anticipation such as a pitcher's wind-up or a golfers' back swing. Feature animation is often less broad than short animation unless a scene requires it to develop a characters personality.

3. Staging:
A pose or action should clearly communicate to the audience the attitude, mood, reaction or idea of the character as it relates to the story and continuity of the story line. The effective use of long, medium, or close up shots, as well as camera angles also helps in telling the story. There is a limited amount of time in a film, so each sequence, scene and frame of film must relate to the overall story. Do not confuse the

audience with too many actions at once. Use one action clearly stated to get the idea across, unless you are animating a scene that is to depict clutter and confusion. Staging directs the audience's attention to the story or idea being told. Care must be taken in background design so it isn't obscuring the animation or competing with it due to excess detail behind the animation. Background and animation should work together as a pictorial unit in a scene.

4. Straight ahead and pose to pose animation:

Straight ahead animation starts at the first drawing and works drawing to drawing to the end of a scene. You can lose size, volume, and proportions with this method, but it does have spontaneity and freshness. Fast, wild action scenes are done this way. Pose to Pose is more planned out and charted with key drawings done at intervals throughout the scene. Size, volumes, and proportions are controlled better this way, as is the action. The lead animator will turn charting and keys over to his assistant. An assistant can be better used with this method so that the animator doesn't have to draw every drawing in a scene. An animator can do more scenes this way and concentrate on the planning of the animation. Many scenes use a bit of both methods of animation.

5. Follow through and overlapping action:

When the main body of the character stops all other parts continue to catch up to the main mass of the character, such as arms, long hair, clothing, coat tails or a dress, floppy ears or a long tail (these follow the path of action). Nothing stops all at once. This is follow through. Overlapping action is when the character changes direction while his clothes or hair continues forward. The character is going in a new direction, to be followed, a number of frames later, by his clothes in the new direction. "DRAG," in animation, for example, would be when Goofy starts to run, but his head, ears, upper body, and clothes do not keep up with his legs. In features, this type of action is done more subtly. Example: When Snow White starts to dance, her dress does not begin to move with her immediately but catches up a few frames later. Long hair and animal tail will also be handled in the same manner. Timing becomes critical to the effectiveness of drag and the overlapping action.

6. Slow-out and Slow-in:

As action starts, we have more drawings near the starting pose, one or two in the middle, and more drawings near the next pose. Fewer drawings make the action faster and more drawings make the action slower. Slow-ins and slow-outs soften the action, making it more life-like. For a gag action, we may omit some slow-out or slow-ins for shock appeal or the surprise element. This will give more snap to the scene.

7. Arcs:

All actions,with few exceptions (such as the animation of a mechanical device), follow an arc or slightly circular path. This is especially true of the human figure and the action of animals. Arcs give animation a more natural action and better flow. Think of natural movements in the terms of a pendulum swinging. All arm movement, head turns and even eye movements are executed on an arc.

8. Secondary Action:

This action adds to and enriches the main action and adds more dimension to the character animation, supplementing and/or re-enforcing the main action. Example: A character is angrily walking toward another character. The walk is forceful, aggressive, and forward leaning. The leg action is just short of a stomping walk. The secondary action is a few strong gestures of the arms working with the walk. Also, the possibility of dialogue being delivered at the same time with tilts and turns of the head to accentuate the walk and dialogue, but not so much as to distract from the walk action. All of these actions should work together in support of one another. Think of the walk as the primary action and arm swings, head bounce and all other actions of the body as secondary or supporting action.

9. Timing:

Expertise in timing comes best with experience and personal experimentation, using the trial and error method in refining technique. The basics are: more drawings between poses slow and smooth the action. Fewer drawings make the action faster and crisper. A variety of slow and fast timing within a scene adds texture and interest to the movement. Most animation is done on twos (one drawing photographed on two frames of film) or on ones (one drawing photographed on each frame of film). Twos are used most of the time, and ones are used during camera moves such as trucks, pans and occasionally for subtle and quick dialogue animation. Also, there is timing in the acting of a character to establish mood, emotion, and reaction to another character or to a situation. Studying movement of actors and performers on stage and in films is useful when animating human or animal characters. This frame by frame examination of film footage will aid you in understanding timing for animation. This is a great way to learn from the others.

10. Exaggeration:

Exaggeration is not extreme distortion of a drawing or extremely broad, violent action all the time. Its like a caricature of facial features, expressions, poses, attitudes and actions. Action traced from live action film can be accurate, but stiff and mechanical. In feature animation, a character must move more broadly to look natural. The same is true of facial expressions, but the action should not be as broad as in a short cartoon style. Exaggeration in a walk or an eye movement or even a head turn will give your film more appeal. Use good taste and common sense to keep from becoming too theatrical and excessively animated.

11. Solid Drawing:

The basic principles of drawing form, weight, volume solidity and the illusion of three dimensions apply to animation as it does to academic drawing. The way you draw cartoons, you draw in the classical sense, using pencil sketches and drawings for reproduction of life. You transform these into color and movement giving the characters the illusion of three-and four-dimensional life. Three dimensional is movement in space. The fourth dimension is movement in time.

12. Appeal:

A live performer has charisma. An animated character has appeal. Appealing animation does not mean just being cute and cuddly. All characters have to have appeal whether they are heroic, villainous, comic or cute. Appeal, as you will use it, includes an easy to read design, clear drawing, and personality development that will capture and involve the audience's interest. Early cartoons were basically a series of gags strung together on a main theme. Over the years, the artists have learned that to produce a feature there was a need for story continuity, character development and a higher quality of artwork throughout the entire production. Like all forms of storytelling, the feature has to appeal to the mind as well as to the eye.

5. VIDEO:

Video refers to pictures in motion. The video medium presents the moving images of real events. Both sound and picture Medias are used for presenting information in the video. It is the excellent way to convey messages to the user in a limited time. The information presented with the video medium retain for a long time in the memory of people.

Video disk is used to store the video documents safely and permanently for future use. It serves as the output of motion pictures and audio. The data are stored in an analog-coded format on the disk. The reproduced data meet the highest quality requirements. Video disk has a diameter of approximately 30 cm and stores approximately 2.6 GB of data.

6. VIDEO FILE FORMATS:

Formats and systems for sorting and playing digitized video to and from disk files are available with Quick Time and AVI. These both systems depend on special algorithms that control the amount of information per video frame that is sent to the screen, as well as the rate at which new frames are displayed. Both provide a methodology for interleaving, or blending, audio data with video and other data so that sound remains synchronized with the video. Both technologies allow data to stream from disk into memory in a buffered and organised manner. Digital Versatile Disk (DVD) is a hardware format defining a very dense, two layered disk that uses laser light to store and read digital information.

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Quick time is an organizer of time -related data in many forms. Classic videotape involves a video track with two tracks of (stereo) audio. It is a multi-track recorder in which unlimited tracks involved. Digitized video, digitized sound, computer animations, MIDI data, external devices like CD-ROM players, hard disks and interactive command systems are supported by the Quick Time format. The heart of

Quick Time is a software -based architecture for seamlessly integrating sound, text, animation, and video on Machintosh and Windows platforms. Quick Time is also used to deliver multimedia to the World Wide Web. On the web Quick Time can deliver 3-D animation, real time special effects, virtual reality and streaming video and audio.

The Building Blocks of Quick Time:

- Quick Time movie file format
- Quick Time Media Abstraction Layer
- Quick Time media services.

Services of Quick Time :

- Timing and synchronization
- Audio and image data compression and decompression
- Image blitting, format conversion, scaling, composition, and transcoding.
- Audio mixing, sample rate conversion, and format conversion
- Audio and video effects and transitions
- Synchronized storage read and write
- Media capture
- Media import and export
- Standard user interface elements, such as movie controllers,media previewers, and media capture dialogs.

JPEG:

- JPEG stands for Joint Photographic Experts Group.
- It is standardization committee.
- JPEG compressed images are often stored in a file format called JFIF (JPEG File Interchange format).
- It has millions of colors.
- It uses lossy-compression to make images smaller in size.
- It is also used for compressing full-motion video on Macintosh, Windows and other platforms.

Mpeg:

- MPEG stands for Moving Picture Experts group.
- It was developed by the Moving Picture Experts group.
- This group is working group convened by International Standards Organization (ISO) and the International Electro-technical Commission (IEC) to create standards for digital representation of moving pictures and audio data.
- MPEG1 and MPEG2 are two current standards.
- MPEG has become widely accepted for both Internet and DVD video.

Dvi:

- DVI Indeo is a proprietary, programmable compression and decompression technology.
- It is based on the Intel i750 chip set.
- This hardware consists of two VLSI components to separate the image procession and display functions.
- Two levels of compression and decompression are provided by DVI: PLV (production level video) and RTV (real time video).
- DVI' s Algorithm can compress video images at rations between 80:1 and 160:1.
- It will play back video in full frame size and full color at 30 frames per second.

7. BROADCAST VIDEO STANDARDS:

Each system is based on a different standard that defines the manner in which information is encoded to generate the electronic signal ultimately creates a television picture. Multi format VCRs can play back all these standards which still requires high end and specialized equipments. These standards define a method for encoding information into the electronic signal that ultimately creates a television picture.

- NTSC
- PAL
- SECAM
- HDTV

NTSC:

- It stands for National Television Standards Committee.
- This is used by USA, Japan and many other countries for broadcasting and displaying video.
- It is based upon the specifications set forth by 1952 National Television Standards Committee.
- As specified by NTSC standard, a single frame of video is made up of 525 horizontal scan lines.(The US NTSC 525-line system joined in 1941).

PAL:

- PAL stands as Phase Alternate Line system.
- It is used in United Kingdom, Europe, Australia, South Africa.
- It is an integrating method of adding colour to a black-and-white television signals that paints 625 lines at a 25 frames per second. (50 Hz system)
- Like NTSC the even and odd lines are interlaced fro each field taking 1/50 of a second to draw.

SECAM:

-
-
- SECAM Stands for Sequential Color and Memory System.
- It is used in France,Rusia and other countries.
- It is a 625 –line,50 Hz system.
- It differs from both PAL and NTSC technology
- TV set sold in Europe can handle PAL AND SECAM systems.

HDTV:

- HDTV stands for High Definition Television.
- HDTV standard included in the Advanced Television System Committee (ATSC).
- Provides high resolution a 16:9 aspect ratio.
- Allows the viewing of Cinema-scope and Panavision Movies.
- Resolution higher than that of standard-definition television (SDTV).
- It is the 1080-line by 1920-pixel formats.
- There is difference between broadcast technology and computer industries.
- Broadcast industry use ultra-high resolution 1920x1080 and computer industry use 1280x720 progressive scan system for HDTV.

Broadcast Video Standards

Three broadcast and video standards and recording formats that are commonly used are:

- NTSC (National Television Standards Committee)
- PAL (Phase Alternate Line System)
- SECAM (Sequential Colour And Memory System)

These standards/formats are not easily interchangeable. Each system is based on a different standard that defines the manner in which information is encoded to generate the electronic signal that ultimately creates a television picture. Multi format VCRs can play back all the three standards but typically cannot dub from one standard to another; dubbing between standards still requires high end, specialized equipment.

NTSC (National Television Standards Committee) It is used by USA, Japan and many other countries for broadcasting and displaying video. It is based upon the specifications set forth by 1952 National Television Standards Committee.

As specified by the NTSC standard, a single frame of video is made up of 525 horizontal scanlines drawn into the inside face of a phospor coated picture tube every $1/30^{th}$ of a second by a fast moving electron beam. The electron beam actually makes two passes as it draws a single video frame, first setting down all the odd numbered lines then all the even numbered lines. Each of these passes (taking place at a rate of 60 per second or 60 Hz) paints a field. This process of building a single frame from two fields is called interlacing, a technique that helps to prevent flicker on TV screens.

Video Compression and Decompression: A video compression and decompression processor is used to compress and decompress video data. The video compression and decompression processor contains multiple stages for compression and decompression. The stages include forward discrete cosine transformation and inverse discrete cosine transformation, quantization and inverse quantization, ZigZag and Zero run-length encoding and decoding, and motion estimation and compensation.

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VIDEO RECORDING FORMATS:

S-VHS VIDEO:

- In this video, color and luminance information are kept on two separate tracks.
- This standard is also used in Hi-8.
- Basically customer oriented format.
- Gaining rapid acceptance among the industrial market (multimedia production)

THREE CHANNEL COMPONENT: (YUV):

- It is developed in 1980s by Sony as the new portable and professional video format.
- It is known Betamax recorded by Betacam.
- Produced images had bleed or crawling edges on grapics.
- Later Panasonic developed their own standard based on similar technology ,called MII.
- Betacam SP became the industry standard for professional analog video field recording.
- This format switched into digital format in 1990s.

COMPOSITE DIGITAL:

- It combines the luminance and chroma information.
- It sample the incoming waveforms and encode the information in binary digital code.
- Reduced image quality weakness and improved color and image resolution.
- Digital copies are made without any loss.
- These formats primarily developed by Sony , Panasonic and Philips.
- D-2 was developed by Ampex and Sony and D-3 was developed by Panasonic.
- Lowest cost equipment and widely used in Multimedia production.

Video Compression

To digitize and store a 10 seconds clip of full motion video in a computer requires transfer of an enormous amount of data, in a very short span of time.

Video display needs at least 30MB per second data transfer rate, which is not possible with present day's technology. But if video data can be compressed to the extent that current data transfer rate supports the video display, it is a solution to the aforesaid problem.

Real time video compression algorithm compresses digital video information at rates that range from 50:1 to 200:1. JPEG, MPEG, P*64 compression schemes use discrete cosine transform, an encoding algorithm that quantifies the human eye's ability to detect color and image distortion.

JPEG The JPEG (Joint Photographic Experts Group) compression scheme was developed for use with static images. It compresses about 20:1, before visible image degradation occurs. JPEG is also used for compressing full-motion video on Macintosh, PC, and other platforms, but at higher compression rates, it is lossy, resulting in a lot of image data getting lost. When a compression ratio of 30:1 is applied to a full color frame of video, the image storage requirement is reduced from 1,000K to 33K, and the data transfer rate is reduced to about 1 MB per second, well within the capabilities of most storage devices.

To compress an image with JPEG, the image is divided into 8 * 8 pixels blocks, and the resulting 64 pixels (called a search range) are mathematically described relative to the characteristic of the pixel in the top-left corner. The binary description of this relationship requires far less than 64 pixels, so more information can be transmitted in less time. JPEG compresses slowly—about one to three seconds for a 1 MB image—depending upon the computer speed, but JPEG can compress images as much as 75:1 with loss.

MPEG The MPEG standard has been developed by the Moving Picture Experts Group, a working group convened by the International Standards Organization (ISO) and the International Electro-technical Commission (IEC) to create standards for digital representation of moving pictures and associated audio and other data. MPEG1 and MPEG2 are the current standards. Using MPEG1, you can deliver 1.2 Mbps (megabits per second) of video and 250Kbps (kilobits per second) of two-channel stereo audio, using CDROM technology. MPEG2, a completely different system from MPEG1, requires higher data rates (3 to 15 Mbps) but delivers higher image resolution, picture quality, interlaced video formats, multiresolution scalability, and multichannel audio features. MPEG has become widely accepted for both Internet and DVD-Video.

DVI Indeo DVI is a proprietary, programmable compression/decompression technology based on the Intel i750 chip set. This hardware consists of two VLSI (Very Large Scale Integrated) components to separate the image processing and display functions.

Two levels of compression and decompression are provided by DVI: Production Level Video (PLV) and Real Time Video (RTV). PLV is a proprietary asymmetrical compression technique for encoding full-motion color video; it requires that compression be performed by Intel at its facilities or at Licensed encoding facilities set up by Intel. RTV provides image quality comparable to frame-rate (motion) JPEG and makes use of a symmetrical, variable-rate compression. PLV and RTV both use variable compression rates.

DVI's algorithms can compress video images at ratios between 80:1 and 160:1. DVI will play back video in full-frame size and in full color at 30 frames per second, whereas JPEG provides only an acceptable image in a small picture window on the computer screen. When tied in with a mainframe computer, DVI playback approaches the quality of broadcast video.

P*64 It is a video telephone conferencing standard for compressing audio and motion video images, from the International Telegraph and Telephone Consultative Committee (CCITT). P*64 complies with CCITT's recommendation H.261, and incorporates multiplexing, demultiplexing, framing of data, transmission protocol and bandwidth congruence, and call setup and teardown. Encoder products from telephone service providers such as AT&T and Northern Telecom use P*64 to deliver wide-spectrum telecommunication capabilities incorporating high speed and very-high throughput data transmission over both copper and fiber optic digital telephone networks.

P*64 encodes real-time motion video and audio for transmission over copper or fiber optic telephone lines at 30 frames per second, at a bandwidth between 40Kbps to 4Mbps.

Other compression systems are being developed by companies including Kodak, Sony, Storm Technology, SuperMac, Iterated Systems and C-Cube Micro-systems, and rapid advancement is being made in this field.

Graphic File Formats

BMP: Windows Device Independent Bitmap

BMP: Windows Device Independent Bitmap

Name	Windows Bitmap
DOS file extension	BMP or DIB
Format type	Bitmap
Versions	Microsoft Windows Version 3.X; OS/2 Presentation Manager
Variations	Windows and OS/2 BMP files vary in file structure; most programs are able to read both.
Compatible operating Systems	Intended for Intel-based PCs
Software that can open or import BMP files	Virtually all Windows programs that utilize bitmaps
Color Capabilities	2, 16, 256, or 16 million colors
Compression	RLE sometimes implemented for 4 and 8-bit images.

CGM: Computer Graphics Metafile

Name	Computer Graphics Metafile
DOS file extension	CGM
Format type	Metafile for vector and bitmap graphics
Versions	Variations depend on how the standard is implemented.
Compatible operating System	Theoretically hardware-neutral
Software that can open or import CGM files	Most vector editing, CAD, and page layout programs.
Color Capabilities	24-bit RGB; variable number of colors in a palette.
Compression	Different encoding schemes determine file size.

DXF: Drawing Interchange Format

Name	Drawing Interchange Format
DOS file extension	DXF
Format type	Vector
Versions	AutoCAD Release 12

Variations	Multiple
Compatible operating Systems	Primarily Amiga; limited compatibility with PC and Macintosh
Software that can open or import IFF/ILBM files	Various bitmap conversion programs for the PC.
Color Capabilities	Black and white, grayscale, 256-color, or 24-bit RGB
Compression	None

DATA COMPRESSION PROCESS:

What is compression? Why is it necessary to compress files?

- Compression refers to reducing the original file size.

- Video and audio files consume more disk space compared to document files.

- While sending the files as attachments in an email, the email may not send the file, as the size is more that it takes.

- Compressed files with less disk space can be sent as attachments in an email.

- Compressed files reduce time to attach, upload and download files.

- Some of the internet servers need only compressed files to upload and download.

Explain about MPEG-2?

- MPEG-2 is one of the international standards for compressing video signals.

- Videos can be compressed prior to transmission or storage.

- The approximate compression ratio is 50:1 of the digital size.

- MPEG-2 standard is widely implemented in digital TV transmission with 200 million decoders.

- MPEG-2 standard exploits the redundancies in the original signal.

Explain MPEG-1 Audio compression standard.

- MPEG-1 is a lossy compression standard for both video and audio.

- It compresses VHS quality raw digital video down to 1.5Mega Bits per Second.

- The compression ration is 26:1

- MPEG-1 introduced MP3 audio format.

- The standard consists of –

1. Systems including synchronization of video, audio and other data.

2. Compressed Video content.

3. Compressed Audio content.

4. Conformance testing.

5. Reference software.

What are the advantages and disadvantages of video compression?

Following are the advantages of Video Compression:

- Occupies less disk space.

- Reading and writing is faster.

- File transferring is faster.

- The order of bytes is independent.

Following are the disadvantages of video compression"

- Compilation need to be done again for compression.

- Errors may occur while transmitting data.

- The byte / pixel relationship is unknown

- Has to decompress the previous data.

What do you mean by lossless source coding?

- Lossless source coding is one of the data compression standards.

- Lossless source coding allows the decompression assures the exact copy of the original data.

- Images, audio and video files use lossless source compression standard.

- Lossless source encoding is suitable for compressing text files.

- It produces fixed length symbols.

What are the JPEG modes of operations?

Following are the JPEG operation modes:

- Lossless Mode: Every pixel in the image is encoded even though the compression ratio is low.

- Sequential Mode: A single scan from left-to-right and top-to-bottom compresses the image.

- Progressive Mode: Multiple scans are used to compress the image. The transmission time is long.

- Hierarchical Mode: Multiple resolutions are used to compress the image. Hence the lower resolution is accessed first which does not require the decompressing the whole resolution of the image.