UNIT 1:

Introduction to Computer Graphics and Devices

Graphics are defined as any sketch or a drawing or a special network that pictorially represents some meaningful information. Computer Graphics is used where a set of images needs to be manipulated or the creation of the image in the form of pixels and is drawn on the computer. Computer Graphics can be used in digital photography, film, entertainment, electronic gadgets, and all other core technologies which are required. It is a vast subject and area in the field of computer science. Computer Graphics can be used in UI design, rendering, geometric objects, animation, and many more. In most areas, computer graphics is an abbreviation of CG. There are several tools used for the implementation of Computer Graphics. The basic is the <graphics.h> header file in Turbo-C, Unity for advanced and even OpenGL can be used for its Implementation.
The term 'Computer Graphics' was coined by Verne Hudson and William Fetter from Boeing who were pioneers in the field.

Computer Graphics refers to several things:

- The manipulation and the representation of the image or the data in a graphical manner.
- Various technology is required for the creation and manipulation.
- Digital synthesis and its manipulation.

Types of Computer Graphics

- **Raster Graphics:** In raster, graphics pixels are used for an image to be drawn. It is also known as a bitmap image in which a sequence of images is into smaller pixels. Basically, a bitmap indicates a large number of pixels together.
- **Vector Graphics:** In vector graphics, mathematical formulae are used to draw different types of shapes, lines, objects, and so on.

Applications

- **Computer Graphics are used for** an **aided design for engineering and architectural system-** These are used in electrical automobiles, electro-mechanical, mechanical, electronic devices. For example gears and bolts.
- **Computer Art –** MS Paint.
- **Presentation Graphics –** It is used to summarize financial statistical scientific or economic data. For example- Bar chart, Line chart.
- **Entertainment-** It is used in motion pictures, music videos, television gaming.
- **Education and training-** It is used to understand the operations of complex systems. It is also used for specialized system such for framing for captains, pilots and so on.
- **Visualization-** To study trends and patterns.For example- Analyzing satellite photo of earth.

Advantages of Interactive Graphics

Interactive graphics in computer graphics offer a wide range of advantages that enhance the user experience and provide numerous practical applications. Some of the key advantages include:

1. **User Engagement:** Interactive graphics actively involve users by allowing them to manipulate and control visual elements. This engagement creates a more immersive and enjoyable experience, leading to increased interest and attention.
2. **Real-Time Interaction:** Users receive instant feedback when interacting with the graphics, enabling them to observe immediate changes based on their actions. Real-time interaction facilitates quick exploration and experimentation.
3. **Exploration and Understanding:** Interactive graphics enable users to explore visual content from different perspectives, zoom in on details, rotate objects, and interact with various elements. This facilitates better understanding and comprehension of complex concepts and data.
4. **Data Visualization:** Interactive graphics are highly effective for visualizing data and information. Users can interact with data points, apply filters, and change parameters to gain insights and discover patterns that may not be evident in static visuals.
5. **Customization:** Interactive graphics allow users to personalize their experience by adjusting settings such as colors, lighting, and viewing angles. Customization enhances user satisfaction and accommodates individual preferences.
6. **Educational Applications:** Interactive graphics are valuable tools in educational settings. They can be used to create interactive tutorials, simulations, and virtual laboratories, promoting active learning and knowledge retention.

7. **Training and Simulation:** In fields like aviation, medicine, and engineering, interactive graphics are utilized for training and simulation purposes. Users can practice tasks, experience scenarios, and develop skills in a risk-free environment.
8. **User Interfaces and User Experience:** Interactive graphics play a crucial role in designing intuitive and user-friendly interfaces. They allow for direct manipulation and visual feedback, enhancing the overall user experience.
9. **Entertainment and Gaming:** Interactive graphics are the foundation of video games and interactive entertainment. Users can control characters, make decisions, and influence the game world, leading to dynamic and immersive gaming experiences.
10. **Virtual Reality (VR) and Augmented Reality (AR):** Interactive graphics are essential in VR and AR applications. They enable users to interact with virtual objects and overlay digital information onto the real world, creating compelling and realistic experiences.
11. **Product Visualization and Marketing:** Interactive graphics are used in product visualization to allow customers to explore and interact with virtual representations of products. In marketing, interactive graphics can engage users in branded content and promotional campaigns.
12. **Data Analysis and Decision-Making:** Interactive graphics aid in data analysis and decision-making processes. Users can interact with visualizations, drill down into specific data points, and test different scenarios, enabling more informed decisions.

Overall, interactive graphics enhance the usability, interactivity, and engagement of computer-generated visuals. They have applications across various industries, from entertainment and education to scientific research, design, and marketing. As technology continues to advance, interactive graphics will continue to play a pivotal role in shaping how we interact with and perceive visual content.

Visualization

Visualization in computer graphics refers to the process of creating graphical representations of data or information to facilitate understanding, analysis, and communication. It involves transforming raw data into visual forms, such as charts, graphs, diagrams, and other interactive visual representations. Visualization is widely used in various fields, including science, engineering, business, education, and more, to gain insights from complex data sets and to communicate findings effectively. Here are some key aspects of visualization in computer graphics:

1. **Data Representation:** Visualization techniques are employed to represent data in a visual format, making it easier for humans to comprehend patterns, trends, and relationships that may not be apparent in raw data.
2. **Visual Abstraction:** Visualization often involves the process of simplifying complex data into abstract visual elements, such as points, lines, bars, and shapes, while preserving essential information.
3. **Data Mapping:** Data attributes are mapped to visual properties, such as color, size, position, and shape. These mappings help convey information effectively and aid in understanding the data distribution.
4. **Interactive Visualization:** Interactive graphics enable users to manipulate visualizations and explore data dynamically. Users can interactively filter, drill down, zoom, and pan to gain deeper insights.
5. **Scientific Visualization:** In scientific fields, visualization is used to represent and analyze data from simulations, experiments, and measurements. It helps scientists understand complex phenomena and validate theoretical models.
6. **Information Visualization:** Information visualization focuses on presenting abstract information, such as textual data, networks, or hierarchical structures, in a visual form. This aids in exploring large datasets and revealing patterns and correlations.
7. **Geospatial Visualization:** Geospatial data, such as maps, satellite imagery, and geographic information systems (GIS) data, are visualized to analyze spatial relationships, plan routes, and make informed decisions.
8. **Time-Series Visualization:** Time-series data is often visualized as line charts, heatmaps, or animations to observe trends, patterns, and seasonal variations over time.
9. **Graph Visualization:** Graphs, representing relationships between entities, are visualized using techniques like node-link diagrams and matrix representations to analyze network structures and connectivity.
10. **Visualization in Design:** Visualization plays a critical role in design fields, such as architecture and industrial design, by creating virtual prototypes and visualizing design concepts.
11. **Business Intelligence (BI):** In the business context, visualization tools are used for business intelligence and data analytics to support decision-making and strategic planning.
12. **Visual Analytics:** Visual analytics combines interactive visualization with data analytics techniques, enabling users to perform complex data analysis while visually exploring data patterns.

What is Data Visualization?

Data visualization is a graphical representation of quantitative information and data by using visual elements like graphs, charts, and maps.

Data visualization convert large and small data sets into visuals, which is easy to understand and process for humans.

Data visualization tools provide accessible ways to understand outliers, patterns, and trends in the data.

In the world of Big Data, the data visualization tools and technologies are required to analyze vast amounts of information.

Data visualizations are common in your everyday life, but they always appear in the form of graphs and charts. The combination of multiple visualizations and bits of information are still referred to as Infographics.

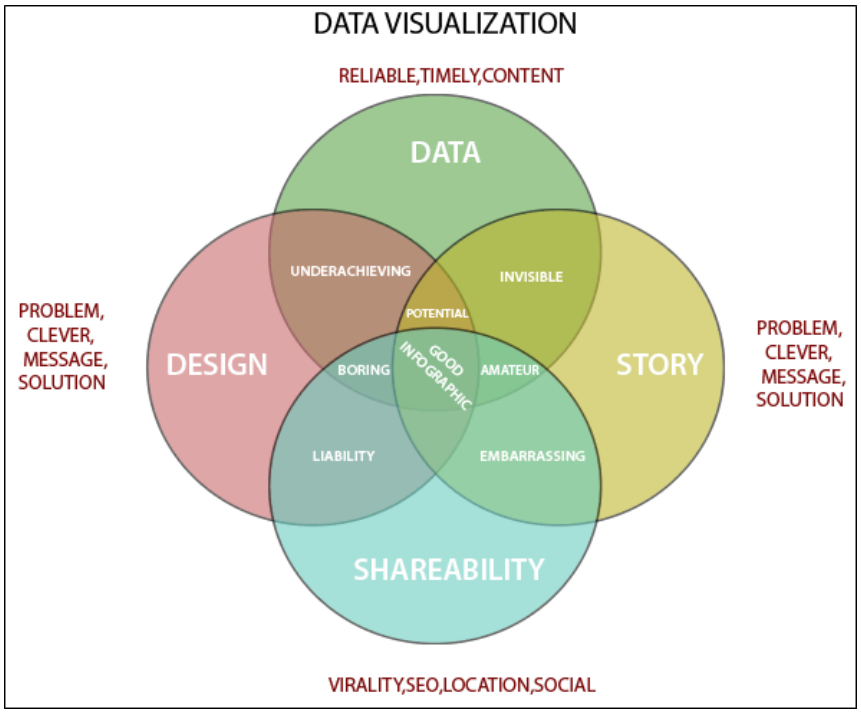
Data visualizations are used to discover unknown facts and trends. You can see visualizations in the form of line charts to display change over time. Bar and column charts are useful for observing relationships and making comparisons. A pie chart is a great way to show parts-of-a-whole. And maps are the best way to share geographical data visually.

Today's data visualization tools go beyond the charts and graphs used in the Microsoft Excel spreadsheet, which displays the data in more sophisticated ways such as dials and gauges, geographic maps, heat maps, pie chart, and fever chart.

What makes Data Visualization Effective?

Effective data visualization are created by communication, data science, and design collide. Data visualizations did right key insights into complicated data sets into meaningful and natural.

American statistician and Yale professor **Edward Tufte** believe useful data visualizations consist of ?complex ideas communicated with clarity, precision, and efficiency.



To craft an effective data visualization, you need to start with clean data that is well-sourced and complete. After the data is ready to visualize, you need to pick the right chart.

After you have decided the chart type, you need to design and customize your visualization to your liking. Simplicity is essential - you don't want to add any elements that distract from the data.

Importance of Data Visualization

Data visualization is important because of the processing of information in human brains. Using graphs and charts to visualize a large amount of the complex data sets is more comfortable in comparison to studying the spreadsheet and reports.

Data visualization is an easy and quick way to convey concepts universally. You can experiment with a different outline by making a slight adjustment.

Data visualization have some more specialties such as:

- Data visualization can identify areas that need improvement or modifications.
- Data visualization can clarify which factor influence customer behavior.
- Data visualization helps you to understand which products to place where.

- Data visualization can predict sales volumes.

Data visualization tools have been necessary for democratizing data, analytics, and making data-driven perception available to workers throughout an organization. They are easy to operate in comparison to earlier versions of BI software or traditional statistical analysis software. This guide to a rise in lines of business implementing data visualization tools on their own, without support from IT.

Why Use Data Visualization?

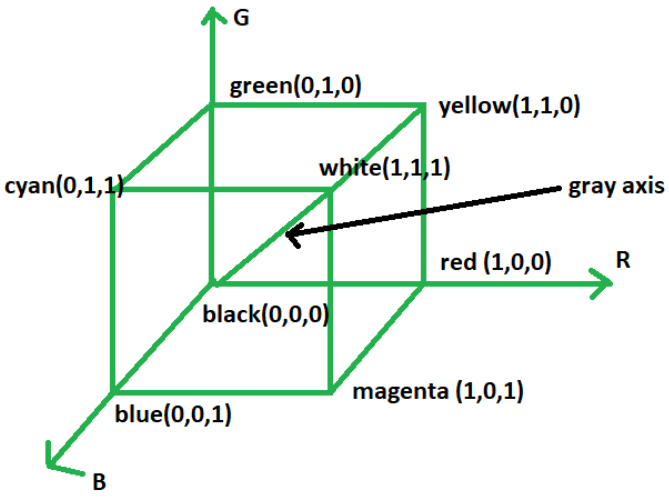
1. To make easier in understand and remember.
2. To discover unknown facts, outliers, and trends.
3. To visualize relationships and patterns quickly.
4. To ask a better question and make better decisions.
5. To competitive analyze.
6. To improve insights.

The RGB color model

The RGB color model is one of the most widely used color representation method in computer graphics. It use a color coordinate system with three primary colors:

R(red), G(green), B(blue)

Each primary color can take an intensity value ranging from 0(lowest) to 1(highest). Mixing these three primary colors at different intensity levels produces a variety of colors. The collection of all the colors obtained by such a linear combination of red, green and blue forms the cube shaped RGB color space.



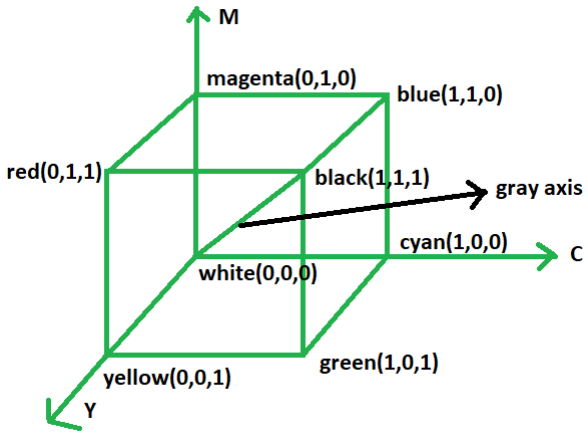
The corner of RGB color cube that is at the origin of the coordinate system corresponds to black, whereas the corner of the cube that is diagonally opposite to the origin represents white. The diagonal line connecting black and white corresponds to all the gray colors between black and white, which is also known as **gray axis**.
In the RGB color model, an arbitrary color within the cubic color space can be specified by its color coordinates: (r, g.b).

Example:
(0, 0, 0) for black, (1, 1, 1) for white,

(1, 1, 0) for yellow, (0.7, 0.7, 0.7) for gray

Color specification using the RGB model is an **additive process**. We begin with black and add on the appropriate primary components to yield a desired color. The concept RGB color model is used in **Display monitor**. On the other hand, there is a complementary color model known as **CMY color model**. The CMY color model use a **subtraction process** and this concept is used in the **printer**.
In CMY model, we begin with white and take away the appropriate primary components to yield a desired color.

Example:
If we subtract red from white, what remains consists of green and blue which is cyan.
The coordinate system of CMY model use the three primaries' complementary colors: C(cray), M(magenta) and Y(yellow)

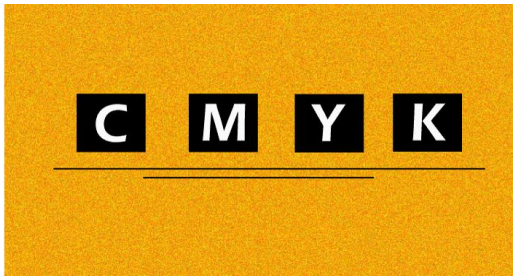


The corner of the CMY color cube that is at (0, 0, 0) corresponds to white, whereas the corner of the cube that is at (1, 1, 1) represents black. The following formulas summarize the conversion between the two color models:

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} C \\ M \\ Y \end{bmatrix} \qquad \begin{bmatrix} C \\ M \\ Y \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

CMYK: Cyan, Magenta, Yellow, and Key

CMYK stands for Cyan, Magenta, Yellow, and Key (black). CMYK is written out completely. The word "key" is taken from black's last letter since B already stands for blue.



It is a four-color ink model that is utilized in color printing. Cyan, magenta, yellow, and black are the colors found on the four printing machine ink plates, sometimes called CMYK. The CMYK creates four distinct colors via a subtractive process.

This technique subtracted the red, green, and blue colors from a white backdrop to reproduce the colors. Below are the results of subtraction:

- Cyan = White - Red
- Magenta = White - Green
- Yellow = Blue + White

The History of CMYK:

The Eagle Printing Ink Company initially created CMYK color printing in 1906. They used examples to show how CMYK can create an infinite number of rich color tones when layered over a white backdrop.

The CMYK Working Process:

Halftoning is actually how CMYK printing operates. It creates a gradient-like look on a photograph by dispersing an image into dots of various sizes and spacing. The dots of primary colors printed in particular patterns can be partially saturated using halftoning. Using this method, we may create variations in color schemes, such as a 20% halftoned magenta color that the human eye perceives as pink.

The CMYK printing process masks other colors, often on a white backdrop. Thus, the ink prevents that specific masked color's reflecting light. All the ink colors are combined to

create the black color in CMYK. This would make production more expensive. So, instead of combining cyan, magenta, and yellow, black creates unsaturated and dark colors.

CMYK's Uses:

In projects involving colored printing, the CMYK is highly demanded. It works well for designs that must be reproduced in paint or ink. Below are a few applications for CMYK:

- Branding apparel such as hoodies and mugs, etc.
- Magazines
- Flyers
- Visiting cards
- Stickers
- Posters
- Billboards
- Posters
- creating a tattoo
- Brochures

File Formats That CMYK Supports:

Every file on a computer is stored using a standard format called a file. Knowing how to save CMYK files for the best color results is important. The three CMYK storage formats are listed below:

Portable Document Formats (PDFs):

Because it works with practically all programs, PDF is the best format for CMYK.

Adobe Illustrator (AI):

The default file format for CMYK is Adobe Illustrator (AI). Only Adobe Illustrator can use it.

Encapsulated PostScript (EPS) Format:

Because it works with vector programs, this is an excellent alternative to AI.

Benefits of CMYK:

The following is a list of CMYK's benefits:

1. Less color processing:

In this procedure, color from a white background is removed as the technique. Less color processing while emphasizing printing.

2. More productivity:

Due to its low cost and simple processing, CMYK is increasingly employed in mass-manufacturing garments.

3. Cost-cutting:

Because subtractive coloring is utilized, printing with fewer colors is possible. This lowers total expenses.

4. Multiple applications:

Because the CMYK coloring process is so widely used, we May use it for various materials and objects.

The Drawbacks of CMYK:

The following are some of the drawbacks of CMYK:

CMYK utilizes a color-reducing approach that reduces brightness compared to the Red, Green, and Blue (RGB) coloring method, giving images a washed-out appearance.

1. Data loss:

The CMYK image's original data is reduced due to its color-reducing approach.

2. Limited color range:

The CMYK color mixture only creates a small, dull palette of colors. Additionally, the colors are presented crudely.

Direct Table

In computer graphics, a direct table, often referred to as a "lookup table" or "LUT," is a data structure used to store and retrieve predefined values for certain operations. It is a one-dimensional array or table where each entry corresponds to a specific input value and holds the corresponding output value.

Direct tables are commonly used in various graphics and image processing operations to speed up computations and simplify complex transformations. Instead of recalculating results for each input value, the table allows the computer to directly access the precomputed output value, resulting in faster processing times.

Here are a few applications of direct tables in computer graphics:

1. **Color Mapping:** In image processing and computer graphics, direct tables are often used for color mapping or color lookups. The table stores the RGB (Red, Green, Blue) values for different color indices, and by referring to the table, the system can quickly convert color indices to their corresponding RGB values.
2. **Gamma Correction:** Gamma correction is used to compensate for the nonlinear relationship between the input voltage and brightness in display systems. A direct table can store precomputed gamma correction values, making it efficient to apply gamma correction to pixel intensities during image display.
3. **Palette-based Graphics:** In old graphics systems that use a limited set of colors, direct tables are used to map pixel values to the corresponding color indices in the palette. This technique allows quick and efficient rendering of images with a restricted color set.
4. **Histogram Equalization:** Histogram equalization is a method used to enhance the contrast of an image by redistributing the intensity levels. Direct tables can store the mapping function, making the process faster and more straightforward.
5. **3D Transformations:** In 3D computer graphics, direct tables can be employed for transformations like rotation or scaling. Instead of repeatedly computing trigonometric functions or complex matrix operations, the table stores precomputed values for specific angles or scaling factors, enabling rapid transformation calculations.
6. **Filtering and Convolution:** In image filtering and convolution operations, direct tables can store kernel coefficients for different filter types. This simplifies the convolution process and enhances the performance of real-time image filtering.

Overall, direct tables play a crucial role in optimizing graphics and image processing operations, particularly those involving repetitive calculations or transformations. By

utilizing precomputed values, direct tables allow for faster and more efficient processing, making them an essential tool in computer graphics and related fields.

Graphics System in Computer Graphics

The term Graphics is defined as any sketch or a drawing or a special network that pictorially represents some meaningful information. Computer Graphics is used where a set of images needs to be manipulated or the creation of the image in the form of pixels and is drawn on the computer. Computer Graphics can be used in digital photography, film, entertainment, electronic gadgets, and all other core technologies which are required. It is a vast subject and area in the field of computer science. Computer Graphics can be used in UI design, rendering, geometric objects, animation, and many more. In most areas, computer graphics is an abbreviation of CG. There are several tools used for the implementation of Computer Graphics. This video explains the concept of Graphic system in Computer Graphic, It gives a brief introduction on five major elements that graphic system consists of they are:

1**. Input devices**: The electromagnetic devices that accept data or a set of instructions from the outside world and then translate that data into machine-readable and understandable form are known as input devices.

2. **Output devices**: An output device is generally reverse of the input process and generally translates the digitized signals into a form intelligible to the user.

3. **Memory**: It is used to store data/information and instructions.

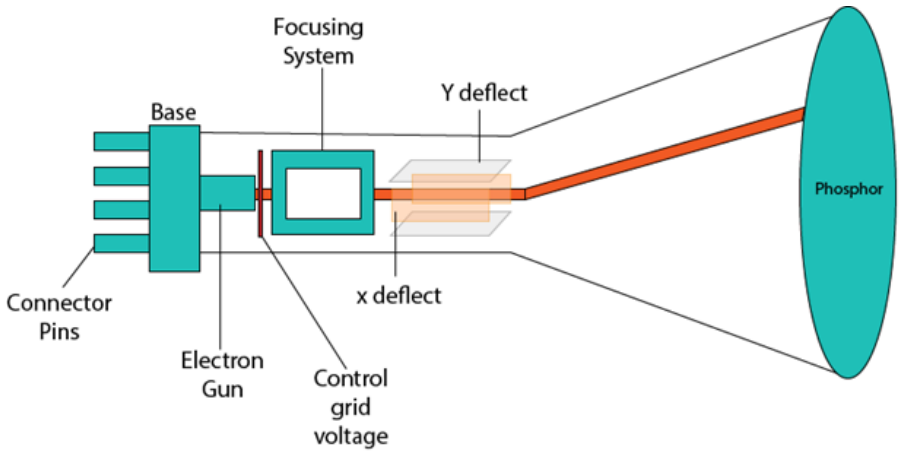
4. **Processor**: The processor also known as CPU is a piece of hardware.

5. **Frame Buffer**: A memory area called refresh buffer or frame buffer stores picture definition.

Cathode Ray Tube (CRT):

CRT stands for Cathode Ray Tube. CRT is a technology used in traditional computer monitors and televisions. The image on CRT display is created by firing electrons from the back of the tube of phosphorus located towards the front of the screen.

Once the electron heats the phosphorus, they light up, and they are projected on a screen. The color you view on the screen is produced by a blend of red, blue and green light.



Cathode Ray Tube

Components of CRT:

Main Components of CRT are:

1. Electron Gun: Electron gun consisting of a series of elements, primarily a heating filament (heater) and a cathode. The electron gun creates a source of electrons which are focused into a narrow beam directed at the face of the CRT.

2. Control Electrode: It is used to turn the electron beam on and off.

3. Focusing system: It is used to create a clear picture by focusing the electrons into a narrow beam.

4. Deflection Yoke: It is used to control the direction of the electron beam. It creates an electric or magnetic field which will bend the electron beam as it passes through the area. In a conventional CRT, the yoke is linked to a sweep or scan generator. The deflection yoke which is connected to the sweep generator creates a fluctuating electric or magnetic potential.

5. Phosphorus-coated screen: The inside front surface of every CRT is coated with phosphors. Phosphors glow when a high-energy electron beam hits them. Phosphorescence is the term used to characterize the light given off by a phosphor after it has been exposed to an electron beam.

Direct View Storage Tube

Direct View Storage Tube (DVST) resembles CRT as it uses electron gun to draw picture and phosphor coated screen to display it. The phosphor used in this is of high persistence. DVST does not use refresh buffer or frame buffer to store picture definition. Picture definition is stored in inside CRT in form positive charged distribution. Because of this reason DVST is knows as Storage Type CRT. In DVST no refreshing is required as result picture drawn on DVST will be seen for several minutes before fading.

Various components of DVST :

1. **Electron guns –**
   Two electron guns are used in DVST : Primary Gun and Flood Gun. Primary gun is used to store picture pattern. Flood gun is used to maintain picture display on phosphor coated screen.
2. **Phosphor Coated Screen –**
   In DVST the inner surface of CRT is coated with phosphor crystals is of high persistence that emit light when beam of electrons strike them.
3. **Storage Mesh –**
   It is thin and high quality wire that is coated with dielectric and is located just behind phosphor coated screen. Primary gun deposits pattern of positive charge on this grid and it is transferred to phosphor coated screen by continuous flood of electrons produced by flood gun. Thus Storage Mesh stores picture to be displayed in form of positive charge distribution.
4. **Collector –**
   This grid is located just behind storage mesh and purpose of this negatively charged grid is to smooth out flow of flood electrons.

Working principle of DVST:

In DVST similar with CRT electron gun and phosphor coated method is used. But in this no electron beam is used to directly writing pictures on screen, but instead of this we can used Storage mesh wire grid is used it is just located behind phosphor coated screen. There is also another grid located just behind storage mesh is called Collector and this purpose is to smooth out flow of flood electrons. The flood gun produce large number of electrons, this negatively charged grid reduces speed of these electrons. Then electrons pass through collector at low velocity and attracted by positive charged portions of storage mesh and strike at portions of phosphor coated screen to display

picture. Some electrons get repelled by other portions of mesh that are negatively charged.
Since the collector has slowly down electrons, in this way they not able to produce sharpened images. So to reduce this problem, screen itself is maintained at a high positive potential by means of voltage applied to thin aluminium coating between tube face and phosphor.

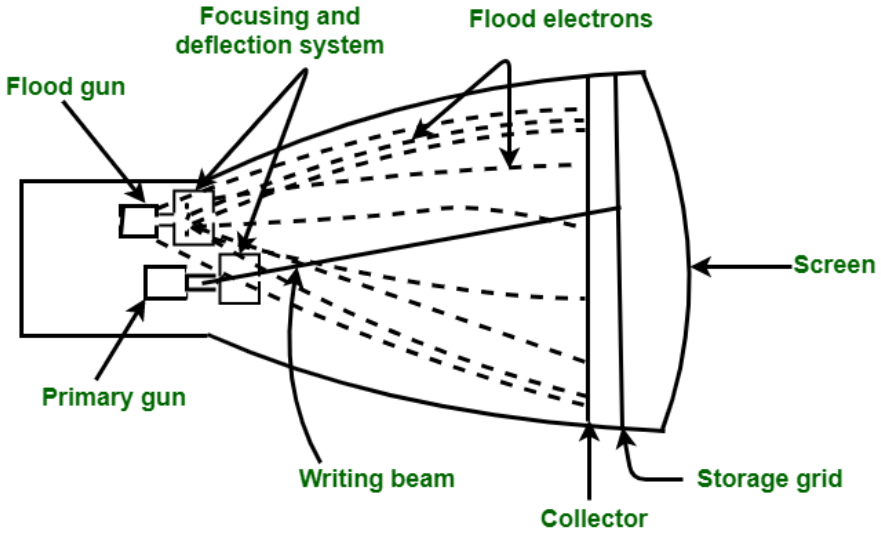


Figure – Direct View Storage Tube

Advantages of DVST :

- For picture display it does not require refreshing.
- Display complex pictures at high resolution without any flicker.
- No use of frame buffer or refresh buffer.

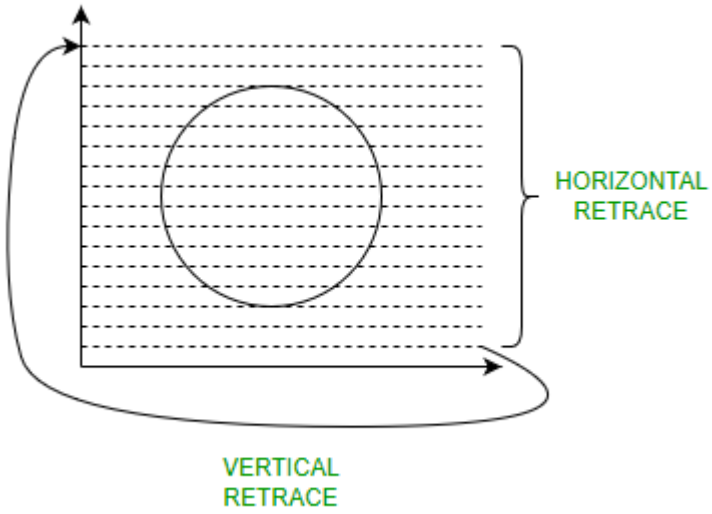
Disadvantages of DVST :

- Not used for dynamic graphic such as animation.
- These systems do not display colors.
- To erase selected part of an image, entire screen needs to be erased and modified pictures needs to be redrawn.

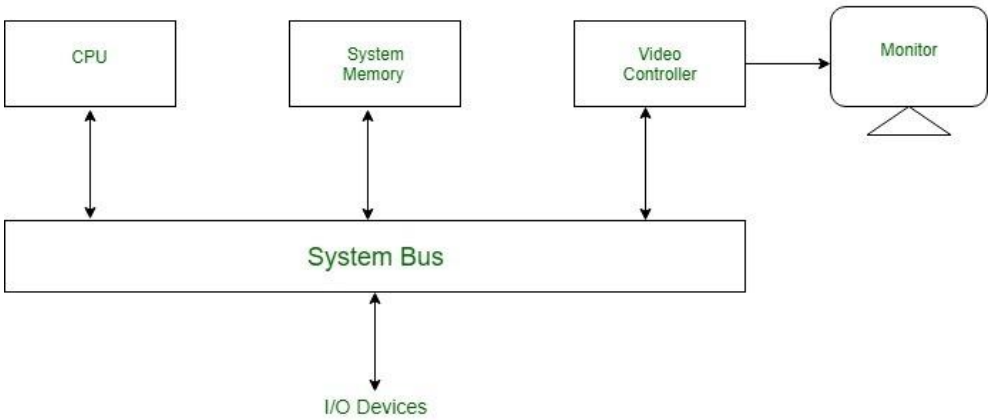
Raster-Scan Displays

Raster Scan Displays are most common type of graphics monitor which employs CRT. It is based on television technology. In raster scan system electron beam sweeps across the screen, from top to bottom covering one row at a time.A pattern of illuminated pattern of spots is created by turning beam intensity on and off as it moves across each row. A memory area called refresh buffer or frame buffer stores picture definition. This memory area holds intensity values for all screen points. Stored intensity values are restored from frame buffer and painted on screen taking one row at a time.Each screen point is referred to as pixels.

In raster scan systems refreshing is done at a rate of 60-80 frames per second. Refresh rates are also sometimes described in units of cycles per second / Hertz (Hz). At the end of each scan line, electron beam begins to display next scan line after returning to left side of screen. The return to the left of screen after refresh of each scan line is known as *horizontal retrace* of electron beam. At the end of each frame electron beam returns to top left corner and begins the next frame.



Raster-Scan Display Processor:
An important function of display process is to digitize a picture definition given in an application program into a set of pixel-intensity values for storage in refresh buffer. This process is referred to as **scan conversion**. The purpose of display processors is to relieve the CPU from graphics jobs.
Display processors can perform various other tasks like: creating different line styles, displaying color areas, etc. Typically display processors are utilized to interface input devices, such as mouse, joysticks.



ADVANTAGES:

- Real life images with different shades can be displayed.
- Color range available is bigger than random scan display.

DISADVANTAGES:

- Resolution is lower than random scan display.
- More memory is required.
- Data about the intensities of all pixel has to be stored.

3D Display:

It is also called stereoscope display technology. This technology is capable of bringing depth perception to the viewer.
It is used for 3D gaming and 3D TVs.
For Example: Fog Display, Holographic Display, Retina Display Etc.
Advantages:

- Impressive Picture Quality
- Impressive Picture Quality
- Impressive Picture Quality

Disadvantage:

- Expensive
- Binocular Fusion

Plotters

Plotters are a special type of output device. It is suitable for applications:

1. Architectural plan of the building.
2. CAD applications like the design of mechanical components of aircraft.
3. Many engineering applications.

Plotter

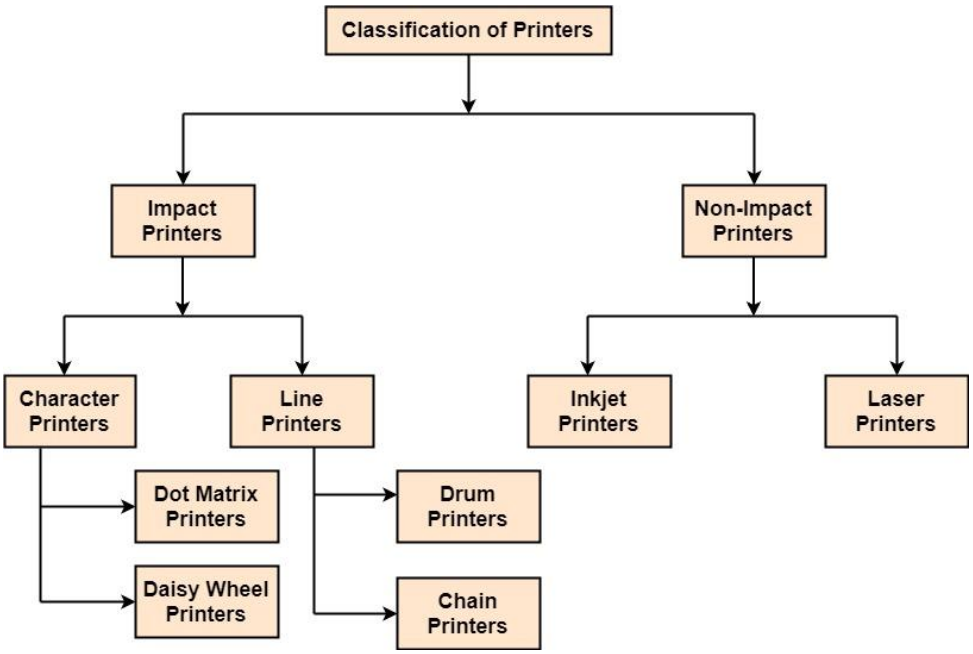
Advantage:

1. It can produce high-quality output on large sheets.
2. It is used to provide the high precision drawing.
3. It can produce graphics of various sizes.
4. The speed of producing output is high.

Printers:

Printer is the most important output device, which is used to print data on paper.

Types of Printers: There are many types of printers which are classified on various criteria as shown in fig:



1. Impact Printers: The printers that print the characters by striking against the ribbon and onto the papers are known as Impact Printers.

These Printers are of two types:

1. Character Printers
2. Line Printers

2. Non-Impact Printers: The printers that print the characters without striking against the ribbon and onto the papers are called Non-Impact Printers. These printers print a complete page at a time, therefore, also known as Page Printers.

Page Printers are of two types:

1. Laser Printers
2. Inkjet Printers

Digitizers:

The digitizer is an operator input device, which contains a large, smooth board (the appearance is similar to the mechanical drawing board) & an electronic tracking device, which can be changed over the surface to follow existing lines. The electronic tracking device contains a switch for the user to record the desire x & y coordinate positions. The coordinates can be entered into the computer memory or stored or an off-line storage medium such as magnetic tape.

Digitizer

Advantages:

1. Drawing can easily be changed.
2. It provides the capability of interactive graphics.

Disadvantages:

1. Costly
2. Suitable only for applications which required high-resolution graphics.

Light Pen

Light Pen (similar to the pen) is a pointing device which is used to select a displayed menu item or draw pictures on the monitor screen. It consists of a photocell and an optical system placed in a small tube. When its tip is moved over the monitor screen, and pen button is pressed, its photocell sensing element detects the screen location and sends the corresponding signals to the CPU.

Light Pen

Uses:

1. Light Pens can be used as input coordinate positions by providing necessary arrangements.
2. If background color or intensity, a light pen can be used as a locator.
3. It is used as a standard pick device with many graphics system.
4. It can be used as stroke input devices.
5. It can be used as valuators

Active and Passive Graphic Devices

In computer graphics, active and passive graphic devices refer to two different types of display technologies used to present visual content to users. These devices have distinct characteristics and applications, each with its advantages and limitations. Let's explore the differences between active and passive graphic devices:

1. **Active Graphic Devices:** Active graphic devices require an external power source to function. They actively manipulate the light emitted from each pixel on the display. These devices are generally more expensive and complex compared to passive devices, but they offer certain benefits, especially in the context of 3D and high-refresh-rate displays.

   Examples of Active Graphic Devices:

   - Active Matrix Liquid Crystal Displays (AMLCD): Commonly known as "TFT" (Thin-Film Transistor) displays, AMLCDs are widely used in modern computer monitors, laptops, and smartphones. Each pixel on an AMLCD is controlled by a dedicated transistor, providing precise control over pixel state changes.
   - Active 3D Glasses: In the context of stereoscopic 3D displays, active 3D glasses contain electronic components and batteries. They synchronize with the display to alternately block each eye's view, providing a stereoscopic 3D effect.

   Advantages of Active Graphic Devices:

   - Faster Response Times: Active devices can change pixel states rapidly, resulting in faster response times and reduced motion blur in fast-moving visuals.
   - High Refresh Rates: Active devices can achieve higher refresh rates, leading to smoother animations and improved visual experiences, especially in gaming.

   Limitations of Active Graphic Devices:

   - Cost: Active devices are generally more expensive to manufacture due to the additional electronics and complex manufacturing processes.
   - Power Consumption: Active devices consume more power, which can impact battery life in portable devices.

2. **Passive Graphic Devices:** Passive graphic devices do not require an external power source to operate. They rely on physical properties and optical mechanisms to display images. Passive devices are simpler and more cost-effective, making them suitable for various applications, particularly in the context of 3D glasses for movie theaters and certain types of 3D displays.

   Examples of Passive Graphic Devices:

   - Passive Matrix LCD Displays: Also known as "DSTN" (Dual-Scan Twisted Nematic) displays, passive matrix LCDs were commonly used in older laptops and small

handheld devices. They are less prevalent today due to limited performance compared to AMLCDs.
- Passive 3D Glasses: In the context of stereoscopic 3D displays, passive 3D glasses do not require batteries or electronic components. They use polarized or color filtering techniques to direct separate images to each eye, providing a stereoscopic 3D effect.

Advantages of Passive Graphic Devices:

- Cost-Effectiveness: Passive devices are generally more affordable to produce, making them suitable for mass-market applications.
- Energy Efficiency: Passive devices do not require an external power source, making them more energy-efficient.

Limitations of Passive Graphic Devices:

- Slower Response Times: Passive devices may exhibit slower response times compared to active devices, leading to potential motion blur in fast-paced content.
- Limited Refresh Rates: Passive devices may have limitations on achieving high refresh rates, which can impact the quality of fast-motion visuals.

In summary, the choice between active and passive graphic devices depends on the specific application, performance requirements, and budget considerations. Active devices are favored for applications demanding fast response times and high refresh rates, while passive devices are more suitable for cost-effective and energy-efficient solutions.

What is Graphics Software?

Graphics software is a type of computer program that is used to create and edit images. There is a wide range of graphics software available on the market, ranging from simple programs that allow users to create and edit basic images, to complex tools that can be used to create detailed 3D models and animations. Some of the most popular graphics software programs include Adobe Photoshop, Corel Painter, and Autodesk Maya.

Characteristics:

- A graphics software program is a computer application used to create digital images.
- Graphics software programs can be used to create both vector and raster images.
- Common features of graphics software programs include the ability to create, edit, and save images in a variety of formats.

- Some graphics software programs also offer features such as the ability to create animations or 3D models.
- Popular examples of graphics software programs include Adobe Photoshop, GIMP, and Inkscape.

Examples:

Some popular graphics software programs are Adobe Photoshop, Adobe Illustrator, and CorelDRAW. These programs can be used to create and edit digital images, illustrations, and logos. They offer a variety of features and tools that allow users to manipulate photos and graphics to create custom designs.

- **Adobe Photoshop** is a popular graphics software used by photographers and graphic designers.
- **Adobe Illustrator** is another popular graphics software used by graphic designers, especially for creating vector illustrations.
- **CorelDRAW** is a graphics software used by both professionals and hobbyists.
- **GIMP** is a free and open source graphics software with capabilities similar to Photoshop.
- **Inkscape** is a free and open source vector graphics software used by graphic designers and illustrators.

Components:

The graphics software components are the tools that you use to create and manipulate your graphic images. These components include the following:

- **Image editors:** These are the tools that you use to create or edit your graphic images. Common image editors include Photoshop, Illustrator, and Inkscape.
- **Vector graphics editors:** These are the tools that you use to create or edit vector graphics. Common vector graphics editors include CorelDRAW and Inkscape.
- **3D modeling software:** This is the software that you use to create three-dimensional models. Common 3D modeling software includes Maya, 3ds Max, and Cinema 4D.
- **Animation software:** This is the software that you use to create animations. Common animation software includes Adobe After Effects, Apple Motion, and Autodesk Maya.
- **Video editing software:** This is the software that you use to edit videos. Common video editing software includes Adobe Premiere Pro, Apple Final Cut Pro, and Avid Media Composer.

Types:

- **Vector graphics software:** This type of software is used to create images made up of lines and shapes, which can be scaled without losing quality. Vector graphics are often used for logos, illustrations, and diagrams.
- **Raster graphics software:** This type of software is used to create images made up of pixels, which cannot be scaled without losing quality. Raster graphics are often used for photos and web graphics.
- **3D graphics software:** This type of software is used to create three-dimensional images and animations. 3D graphics are often used for product visualization and gaming.
- **Animation software:** This type of software is used to create moving images, either by animating existing graphics or by creating new ones from scratch. Animation software is often used for movies, commercials, and video games.

Applications:

The applications are used by professionals in a variety of fields, including graphic design, photography, video editing, and web design. There are a wide variety of graphics software applications available, each with its own unique set of features and capabilities. It is important to choose the right application for the specific task at hand.

- It can be used to create and edit logos, and other graphical elements.
- It can be used to create website layouts and design elements.
- It can be used to create illustrations, visual presentations, and digital art.
- It can be used to edit and enhance photos, images, and animation.
- It can be used to create and edit website designs, presentation slides, and marketing materials.

Advantages:

There are many advantages of using graphics software, including the ability to create high-quality images, edit images and create custom graphics.

- Graphics software provides users with a wide range of tools to create, edit and manipulate images.
- It is often easy to use and can be used by people with little or no experience in image editing.

- It can be used to create images for a wide range of purposes, including web design, advertising, and printing.
- It often provides a wide range of features, making it possible to create complex images with ease.
- It is often able to create images in a range of different formats, making it easy to share images with others.
- It provides users with a wide range of tools to create, edit, and manipulate images.
- It can be used to create both vector and bitmap images.
- It offers a variety of features and options that allow users to create images that are both creative and professional.
- It is often used in conjunction with other software programs, such as word processors and spreadsheets, to create comprehensive documents and presentations.

Disadvantages:

- Many graphics software programs are expensive, and the cost can be a barrier for some people who want to use them.
- It requires a lot of memory to store huge files.
- Some graphics software programs can be complex and difficult to use, which can be complicated for some users.
- It requires a powerful computer to work with the project smoothly.
- It can be time-consuming to create graphics.
- It can be expensive to purchase the software, and then you also have to pay for the subscription regularly.
- It can be difficult to learn how to use the software, especially if you are not familiar with graphic design.
- Some graphics software programs only offer limited functionality, which can be frustrating for users who want to do more with their images.