Computer Graphics

Lecture 2

By

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Based on Computer Graphics By Hearn & Baker

What do you mean by computer graphics?

The branch of science and technology concerned with methods and techniques for converting data to or from visual presentation using computers.

What are the applications of computer graphics?

1. Computer Aided Design
2. Graphical User Interface
3. Entertainment
4. Simulation and Training
5. Education and Presentation
6. Computer Generated Art
7. Scientific Visualization
8. Image Processing
9. Virtual reality
10. Cartography

What do you mean by interactive computer Graphics?

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.

What do you mean by GUI?

GUI stands for Graphical user interface. A major component of a GUI is a window manager that allows a user to display multiple-window areas. To make a particular window active we simply click in that window using an interactive pointing device. Interfaces also display menus and icons for fast selection of processing options or parameter values.

What does it mean by RGB?

The RGB is a color model, 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.

Define VDU?

- A monitor or display (sometimes called a **visual display unit**) is a piece of electrical equipment which displays images generated by devices such as computers, without producing a permanent record.
- The monitor comprises the display device, circuitry, and an enclosure. The display device in modern monitors is typically a **thin film transistor liquid crystal display** (TFT-LCD), while older monitors use a **cathode ray tube** (CRT).

Define persistence in terms of CRT Phosphorous.

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.

Define resolution

The maximum number of points that can be displayed without overlap on a CRT is referred to as the resolution.

What do you mean by an aspect ratio?

Aspect ratio is a number which gives the ratio of vertical points to horizontal points necessary to produce equal length lines in both directions on the screen. An aspect ratio of ¾ means that a vertical line plotted with three points has same length as a horizontal line plotted with 4 points.

What are the different properties of phosphorus?

1. Color
2. Persistence

Differentiate raster and random scan displays.

In a raster scan displays the electron beam is swept across the screen, one row at a time from top to bottom. Contrasting in random scan displays the electron beam is directed to the parts of the screen where a picture is to be drawn.

Define refresh buffer/Frame buffer?

Picture definition is stored in a memory area called the refresh buffer or frame buffer. This memory area holds the set of intensity values for all the screen points.

Define Pixel.

Each screen point is referred to as a pixel.

Define bitmap.

On a black and white system with one bit per pixel, the frame buffer is commonly known as a bitmap.

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.

What do you mean by interlacing?

It is the method of incrementally displaying a visual on a CRT. On some raster scan systems, each frame is displayed in two passes using an interlaced refresh procedure. In the first pass, the beam sweeps across every other scan line from top to bottom. Then after the vertical retrace, the beam sweeps out the remaining scan lines. Interlacing of the scan lines in this way allows us to see the entire screen displayed in one-half the time it would have taken to sweep across all the lines at once from top to bottom. Interlacing is primarily used with slower refreshing rates.

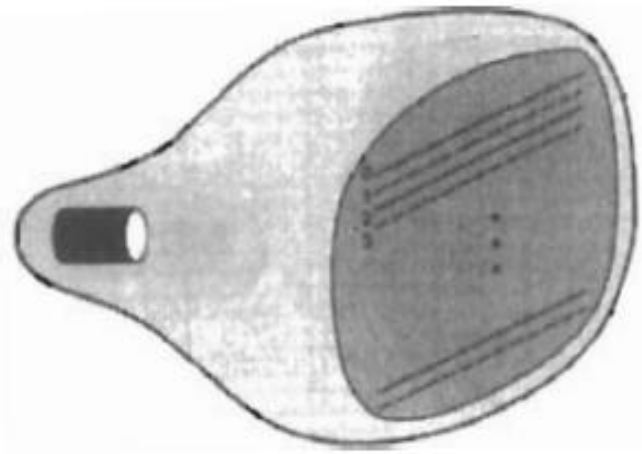

Figure 2-8
Interlacing scan lines on a raster-scan display. First, all points on the even-numbered (solid) scan lines are displayed; then all points along the odd-numbered (dashed) lines are displayed.

What is a Beam penetration method?

This technique is used in random scan display systems. Two layers of phosphor (red and green) are coated onto the inside of the CRT screen, the displayed colors depends on how far the electron beam penetrates into the phosphors layers. A slow electron beam excites only the outer red layer. A very fast electron beam penetrates trough the red layer and hence excites the green layer. An average electron beam gives the combination of red and green color. That is yellow and orange. This technique only provides four colors.

Advantages and Disadvantages of Beam penetration method?

- 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

Define shadow masking

- **This technique is used in raster scan display devices. It gives much wider range of colors than a beam penetration method.**
- **A shadow Mask CRT has three phosphor color dots at each pixel location. One phosphor dot emits a red light, another emits green light and the last one emits a blue light. This type of CRT also has three electron guns one for each color dot.**
- **A shadow mask grid is installed just behind the phosphor coated screen. The three electron beams are deflected and focused as a group onto the shadow mask, which contains a series of very fine holes aligned with the phosphor dot patterns. When the three beams pass through a hole in the shadow mask, they activate a dot triangle, which appears as a small color spot on the screen.**
- **Different colors can be obtained by varying the intensity levels.**
- **More than 17 million different colors can be obtained in a full color system.**

What are composite monitors?

Composite monitors are the adaptations of TV sets that allow bypass of the broadcast circuitry. These display devices still require that the picture information be combined, but no carrier signal is needed. Picture information is combined into a composite signal and then separated by the monitor, so the resulting picture quality is still not the best attainable.

Direct view storage tubes (DVST)

An alternative method for maintaining a screen image is to store the picture information inside the CRT instead of refreshing the screen. A direct-view storage tube (DVST) stores the picture information as a charge distribution just behind the phosphor-coated screen. Two electron guns are used in a DVST. One, the primary gun, is used to store the picture pattern; the second, the flood gun, maintains the picture display.

What are advantages of direct view storage tubes (DVST) over CRT? Also list some disadvantages of DVST.

A DVST monitor has both disadvantages and advantages compared to the refresh CRT. Because no refreshing is needed, very complex pictures can be displayed at very high resolutions without flicker.

Disadvantages of DVST systems are that they ordinarily do not display color and that selected parts of a picture cannot he erased. To eliminate a picture section, the entire screen must be erased and the modified picture redrawn. The erasing and redrawing process can take several seconds for a complex picture. For these reasons, storage displays have been largely replaced by raster systems.

Flat-Panel Displays

- 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.

Differentiate emissive and non-emissive displays.

- We can separate flat-panel displays into two categories: emissive displays and non-emissive displays.
- Emissive displays (or emitters) are devices that convert electrical energy into light. Plasma panels, thin-film electroluminescent displays, and Light-emitting diodes are examples of emissive displays.
- Non-emissive displays use optical effects to convert sunlight or light from some other source into graphics patterns. The most important example of a non-emissive flat-panel display is a liquid-crystal device.

Plasma panels

Plasma panels, also called gas-discharge displays, are constructed by filling the region between two glass plates with a mixture of gases that usually includes neon. A series of vertical conducting ribbons is placed on one glass panel, and a set of horizontal ribbons is built into the other glass panel. Firing voltages applied to a pair of horizontal and vertical conductors cause the gas at the intersection of the two conductors to break down into a glowing plasma of electrons and ions. Picture definition is stored in a refresh buffer, and the firing voltages are applied to refresh the pixel positions (at the intersections of the conductors) 60 times per second.

Explain the merits and demerits of Plasma panel display

ADVANTAGES:

- Refreshing is not required
- Produce a very steady image free of Flicker
- Less bulky than a CRT.

DISADVANTAGES:

- Poor resolution of up to 60 d.p.i
- It requires complex addressing and wiring
- It is costlier than CRT.

Thin-film electroluminescent

Thin-film electroluminescent displays are similar in construction to a plasma panel. The difference is that the region between the glass plates is filled with a phosphor, such as zinc sulfide doped with manganese, instead of a gas.

light-emitting diode (LED)

A third type of emissive device is the light-emitting diode (LED). A matrix of diodes is arranged to form the pixel positions in the display, and picture definition is stored in a refresh buffer. As in scan-line refreshing of a CRT, information is read from the refresh buffer and converted to voltage levels that are applied to the diodes to produce the light patterns in the display.

Liquid Crystal displays (LCDS)

Liquid Crystal displays (LCDS) are commonly used in small systems, such as calculators and portable, laptop computers. These non-emissive devices produce a picture by passing polarized light from the surroundings or from an internal light source through a liquid-crystal material that can be aligned to either block or transmit the light.

List some 3D viewing devices

1. Stereoscopic systems
2. Virtual reality systems

What is the role of a video controller?

- Also known as Graphics controller - Display controller - Display processor.
- It is the one of the component of an interactive raster scan system. It is used to control the operation of the display device by accessing the frame buffer to refresh the screen.

What do you mean by 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.

What is the difference between impact and non-impact printers?

- Impact printers press formed character faces against an inked ribbon on to the paper.
  - A line printer and dot-matrix printer are examples.
- Non-impact printer and plotters use Laser techniques, inkjet sprays, Xerographic process, electrostatic methods and electro thermal methods to get images onto the papers.
  - Examples are: Inkjet/Laser printers.

What is the features of Inkjet printers?

Features:

- They can print 2 to 4 pages/minutes.
- Resolution is about 360d.p.i. Therefore better print quality is achieved.
- The operating cost is very low. The only part that requires replacement is ink cartridge.

4 colors cyan, yellow, majenta, black are available.

What are the advantages of laser printers?

- High speed, precision and economy.
- Cheap to maintain.
- Quality printers.
- Lasts for longer time.
- Toner power is very cheap.

What is the advantages of electrostatic plotters?

- They are faster than pen plotters and very high quality printers.
- Recent electrostatic plotters include a scan-conversion capability.
- Color electrostatic plotters are available. They make multiple passes over the paper to plot color pictures.

Consider three different raster systems with resolutions of 640 x 480, 1280 x 1024, and 2560 x 2048. What size is frame buffer (in bytes) for each of these systems to store 12 bits per pixel?

Answer

Because eight bits constitute a byte, frame-buffer sizes of the systems are as follows:

- 640 x 480 x 12 bits / 8 = 450KB;
- 1280 x 1024 x 12 bits / 8 = 1920KB;
- 2560 x 2048 x 12 bits / 8 = 7680KB;

Consider three different raster systems with resolutions of 640 x 480, 1280 x 1024, and 2560 x 2048. How much storage (in bytes) is required for each system if 24 bits per pixel are to be stored?

Answer

Similarly, the previous results is just doubled for 24 (12×2) bits of storage per pixel.

Consider two raster systems with the resolutions of 640 x 480 and 1280 x 1024. How many pixels could be accessed per second in each of these systems by a display controller that refreshes the screen at a rate of 60 frames per second?

Answer

- Since 60 frames are refreshed per second and each frame consists of 640 x 480 pixels, the access rate of such a system is (640 x 480) * 60 = 1.8432 x 107 pixels/second.
- Likewise, for the 1280 x 1024 system, the access rate is (1280 x 1024) * 60 = 7.86432 x 107 pixels/second.

Consider two raster systems with the resolutions of 640 x 480 and 1280 x 1024. How many pixels could be accessed per second in each of these systems by a display controller that refreshes the screen at a rate of 60 frames per second? What is the access time per pixel in each system?

Answer

- According to the definition of access rate, we know that the access time per pixel should be 1/(access rate).
- Therefore, the access time is around 54 nanoseconds/pixel for the 640 x 480 system, and the access time is around 12.7 nanoseconds/pixel for the 1280×1024 system.

Consider a raster system with the resolution of 1024 x 768 pixels and the color palette calls for 65,536 colors. What is the minimum amount of video RAM that the computer must have to support the above-mentioned resolution and number of colors?

Answer

- Recall that the color of each pixel on a display is represented with some number of bits. Hence, a display capable of showing up to 256 colors is using 8 bits per pixels (i.e. "8-bit color").
- Notice first that the color palette calls for 65,536 colors. This number is but 2^{16} , which implies that 16 bits are being used to represent the color of each pixel on the display. The display's resolution is 1024 by 768 pixels, which implies that there is a total of 786,432 (1024 × 768) pixels on the display. Hence, the total number of bits required to display any of 65,536 colors on each of the screen's 786,432 pixels is 12,582,912 (786,432 × 16).
- 12,582,912 bits = 1,572,864 bytes = 1,536 KB = 1.5 MB.

Temp

- Last update on 29 – October 2014