**Q1) Explain in detail video display device such as CRT.**

1. A beam of electrons emitted by the electro gun passing through focussing and deflections systems that direct the beam towards specified positions on the phosphor coated system.
2. The phosphor then emits a small spot of light at each position contacted by the electrons beam.
3. Because the light emitted fades rapidly, the picture is redrawn repeatedly by quickly directing the electron beam back over the same points, to keep the phosphor glowing. This type of display is called refresh CRT.
4. The primary components of an electron gun in a CRT are the heated metal cathode and a control grid.
5. Heat is supplied to the cathode by directing a current through a coil of wire called the filament inside the cylindrical cathode structure.
6. This causes electron to be ‘boiled off’ the hot cathode surface. In the vacuum inside the CRT envelop, the free negative charged electron are the accelerated. Toward the phosphor coating by a high positive voltage.
7. Intensity of the electron beam is controlled by setting voltage levels on the control grid, which is a metal cylinder that fits over the cathode.
8. The amount of light emitted by the phosphor coating depends on the number of electron striking the screen; the brightness of a display can be controlled by varying the voltage on the control grid.
9. The focussing system is needed to force the beam to converge into a small spot as it strikes the phosphor.
10. Electrostatic focussing, the electron beam passes through a positively charged metal cylinder that forms an electrostatic lens. The action of the lens focuses the electron beam at the centre of the screen.
11. The distance that the electron beam must travel to different points on the screen varies because the radius of the curvature for most CRTs is greater that the distance from the focusing system to the screen centre.
12. Therefore the electron beam is focused properly at the centre of the screen at the beam moves to the outer edges of the screen, displayed images become blurred.
13. The deflections of the electron beam can be controlled wither with electric fields or with magnetic fields.
14. Hen electrostatic deflection is used, two pairs of parallel plates are mounted inside the CRT envelops. One pair of plate is mounted horizontally to control vertical deflection and the outer pair is mounted vertically to control horizontal deflection.
15. Persistence is defined as the time it takes the emitted light from the screen to decay to 1/10th of its original intensity.
16. Resolution is the number of points per centimetre that can be plotted horizontally and vertically.
17. Aspect Ratio is the number that gives the ration of the partial points to horizontal points necessary to produce equal length line in both directions on the screen.

**Q2) Give the difference between raster scan and random scan system.**

Raster Scan display

1. The electron beam is swept 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/off to create a pattern of illuminated spots.
2. The picture is drawn and refreshed from top to bottom of the screen.
3. It is suited form realistic display of screen containing suitable shading and colour pattern. E.g. TV, printers
4. Picture definition is stored as a set of intensity values for all screen points.
5. Lower resolution compared to random scan system.
6. Raster system produces jagged lines that are plotted as discrete point sets. Random Scan Display
7. The electron beam is directed only to the parts of the screen where a picture is to be drawn; it draws a picture one line at a time.
8. The component lines of picture can be drawn and refreshed in any specified order.
9. They are designed for line drawing applications.
10. Picture definition is stored as a set of line drawing instructions.
11. Vector displays generally have higher resolution.
12. It produces smooth line drawings because CRT beam directly follows the line path.

**Q3) Write a short note on:**

1. **Colour CRT monitors**

CRT monitors displays colour pictures by using a combination of phosphor that emit different coloured light. By combining the emitted light from the different phosphor, a range of colours can be generated. The two basic techniques for producing colour displays with a CRT are the beam penetrating method for displaying colour pictures has been used with random scan monitors. Two layers of phosphor are coated onto the inside of the CRT screen and the displayed colour depends on how far the electron beam penetrates into the phosphor layers. A beam of slow electrons excites only the outer real layer. A beam of very fast electrons penetrates through the real layer and excites the inner green layer. The speed of the electrons and hence the screen colour at any point is controlled by the beam accelerating voltage.

Shadow mask methods are commonly used in raster scan systems because they produce a much wider range of colours than the beam penetration method. A shadow mask CRT has three phosphor colour dots at each pixel position; red, green and blue. This type of CRT has three electron guns, one for each colour dot and a shadow mask grid 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 holes aligned with the phosphor dot patterns.

1. **Direct Voltage 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 device stores the picture information as a charge distribution just behind the phosphor coated screen. Two electron guns are used in DVST. The primary gin is used to store the picture pattern, the flood gun maintains the picture display.

Advantage: Since no refreshing is needed, very complex pictures can be displayed at very high resolutions without flicker.

Disadvantage: It does not display colour and selected parts of a picture cannot be erased. To eliminate a picture section, the entire screen must be erased and the modified picture redrawn; which can take several seconds for a complex picture.

1. **Flat Panel displays**

The term flat panel display refers to a class of video devices that have reduced volume, weight and power requirements compared to CRT. A significant feature of flat panel display is that they are thinner than CRT. They can be categorised into:

* Emissive displays - These used light converted from electrical energy. E.g. plasma panels, light emitting diodes
* Non emissive displays - These use optical effects to convert sunlight or light from other sources into graphics patterns. E.g. liquid crystal displays

Current uses for flat panel displays include small TV monitors, calculators, pocket video games, laptop computers etc.

**Q4) Give the difference between emissive displays and non emissive displays.**

Emissive displays – These are devices that use light converted from electrical energy. Plasma panels, light film electroluminescent displays and light emitting diodes are examples of emissive displays. Flat CRTs have not proved to be as successful as other emissive displays.

Non emissive displays - These use optical effects to convert sunlight or light from other sources into graphics patterns. The most important example of non emissive displays is liquid crystal displays (LCDs).

**Q5) Give the architecture of raster graphics system.**

A fixed area of the system memory is reserved for the frame buffer and the video controller is given direct access to the frame buffer memory. Frame buffer locations and the corresponding screen positions are referenced in Cartesian coordinates. For many graphics monitors, the coordinates of the origin is defined at the lower left screen corner. Two registers are used to store the coordinates of the screen pixels. Initially the x register is set to 0 and the y register is set to ymax. The values stored in the frame buffer for this pixel positionis then retrieved and used to set the intensity of the CRT beam. Then the x register is incremented by one and the process is repeated for the next pixel on the top scan line. After the last pixel on the top scan line has been processed, the x register is reset to 0 and the y register is decremented by one. The pixels along this scan line are then processed in turn and the procedure is repeated for each successive scan line.

**Q6) What does scan conversion mean?**

A major task of the display processor is digitising a picture definition given in an application program into a set of pixel intensity values for storage in the frame buffer. This digitisation process is called scan conversion. Graphics commands specifying straight lines and other geometric objects are scan converted into a set of discrete intensity points. Scan converting a straight line segment, for e.g. means that we have to locate the pixel position closest to the line path and store the intensity for each position in the frame buffer.

**Q7) Explain the following input devices:**

1. **Mouse**

A mouse is a small hand held box used to position the screen cursor. Wheels or rollers on the bottoms of the mouse can be used to record the amount and direction of movement. Another method for detecting mouse motion is optical sensor. For these systems, the mouse is moves over a special mouse pad, which has grid of vertical and horizontal lines. The optical sensors detect movement across the lines in the grid. Since a mouse can be picked up and put down at another position without change in the cursor movement, it is used for making relative changes in the position of the screen cursor. One, two or three buttons are usually placed on top of the mouse for signalling the execution of some operation.

1. **Keyboard**

An alphanumeric keyboard on a graphics system is used primarily as a device for entering text strings. The keyboard is an efficient device for inputting such non-graphic data as picture labels associated with a graphics display. Keyboards can also be provided with features to facilitate entry of screen coordinates, menu selections, or graphics functions. Cursor-control keys and function keys are common features on general- purpose keyboards. Function keys allow users to enter frequently used operations in a single keystroke, and cursor-control keys can be used to select displayed objects or coordinate positions by positioning the screen cursor. Other types of cursor-positioning devices, such as a trackball or joystick, are included on some keyboards. Additionally, a numeric keypad is, often included on the key- board for fast entry of numeric data. For specialized applications, input to a graphics application may come from a set of buttons, dials, or switches that select data values or customized graphics operations.

1. **Joystick**

A joystick consists of a small, vertical lever (called the stick) mounted on a base that is used to steer the screen cursor around. Most joysticks select screen positions with actual stick movement; others respond to pressure on the stick. Some joysticks are mounted on a keyboard; others function as stand-alone units. The distance that the stick is moved in any direction from its centre position corresponds to screen-cursor movement in that direction. Potentiometers mounted at the base of the joystick measure the amount of movement, and springs return the stick to the centre position when it is released.

1. **Touch panels**

Touch panels allow displayed objects or screen positions to be selected with the touch of a finger. A typical application of touch panels is for the selection of processing options that are represented with graphical icons. Some systems are designed with touch screens. Other systems can be adapted for touch input by fitting a transparent device with a touch-sensing mechanism over the video monitor screen. Touch input can be recorded using optical, electrical, or acoustical methods. Optical touch panels employ a line of infrared light-emitting diodes (LEDs) along one vertical edge and along one horizontal edge of the frame. The opposite vertical and horizontal edges contain light detectors. These detectors are used to record which beams are interrupted when the panel is touched. Positions tin be selected with an accuracy of about 1/4 inch

1. **Light pens**

Light pen are pencil-shaped devices are used to select screen positions by detecting the light coming from points on the CRT screen. They are sensitive to the short burst of light emitted from the phosphor coating at the instant the electron beam strikes a particular point. Other Light sources, such as the background light in the room, are usually not detected by a light pen. An activated light pen, pointed at a spot on the screen as the electron beam lights up that spot, generates an electrical pulse that causes the coordinate position of the electron beam to be recorded.

1. **Track balls and space balls**

A trackball is a ball that can be rotated with the fingers or palm of the hand to produce screen-cursor movement. Potentiometers, attached to the ball, measure the amount and direction of rotation. Trackballs are often mounted on keyboards or other devices such as the Z mouse. While a trackball is a two-dimensional positioning device, a spaceball provides six degrees of freedom. Unlike the trackball, a spaceball does not actually move. Spaceballs are used for three-dimensional positioning and selection operations in virtual-reality systems, modelling, animation, CAD, and other applications.

1. **Image scanners**

Drawings, graphs, colour and black-and-white photos, or text can be stored for computer processing with an image scanner by passing an optical scanning mechanism over the information to be stored. The gradations of gray scale or colour are then recorded and stored in an array. Once we have the internal representation of a picture, we can apply transformations to rotate, scale, or crop the picture to a particular screen area. We can also apply various image-processing methods to modify the array representation of the picture. For scanned text input, various editing operations can be performed on the stored documents. Some scanners are able to scan either graphical representations or text, and they come in a variety of sizes and capabilities.

**Q8) Explain the basic attributes of lines and curves.**

* Line attributes: Basic attributes of a straight line segment are its type, its width, and its colour. In some graphics packages, lines can also be displayed using selected pen or brush options.
* Line type: Possible selections for the line type attributes include solid lines, dashed lines and dotted lines. A dashed line could be displayed by generating an inter-dash spacing that is equal to the length of the solid section. A dashed line could be displayed by generating an inter-dash spacing that is equal to the length of the solid sections.
* Line width: We set the line-width attribute with the command:

setLineWidthScaleFactor(lw)

Line-width parameter *lw* is assigned a positive number to indicate the relative width of the line to be displayed. A value of 1 specifies a standard-width line.

* Pen & brush options: Lines can be displayed with pen or brush selections. Options in this category include shape, size, and pattern. These shapes can be stored in a pixel mask that identifies the array of pixel positions that are to be set along the line path.
* Line colour: When a system provides colour (or intensity) options, a parameter giving the current colour index is included in the list of system-attribute values. A poly-line routine displays a line in the current colour by setting this colour value in the frame buffer at pixel locations along the line path using the setpixel procedure.
* Curve attributes: Parameters for curve attributes are the same as those for line segments. Raster curves of various widths can be displayed using the method of horizontal or vertical pixel spans. Where the magnitude of the curve slope is less than 1, we plot vertical spans; where the slope magnitude is greater than 1, we plot horizontal spans. Another method for displaying thick curves is to fill in the area between two parallel curve paths, whose separation distance is equal to the desired width. A uniform curve thickness can be displayed by rotating the rectangular pen to align it with the slope direction as we move around the curve or by using a circular pen shape.

**Q9) Describe the scheme for storing colour values in colour lookup table.**

In a colour lookup table (or video lookup table), frame-buffer values are stored as indices into the colour table. Each pixel can reference any one of the 256 table positions, and each entry in the table uses 24 bits to specify an RGB colour. For the colour code 2081, a combination green-blue colour is displayed for pixel location (x, y). Systems employing this particular lookup table would allow the user to select any 256 colours for simultaneous display from a palette of nearly 17 million colours. Compared to a full-colour system, this scheme reduces the number of simultaneous colours that can be displayed, but it also reduces the frame- buffer storage requirements to 1 megabyte.

**Q10) Give the intensity codes for a four level greyscale system.**

|  |  |  |
| --- | --- | --- |
| Intensity codes | Stored intensity values in frame buffer (binary code) | Displayed greyscale |
| 0.00 | 00 | Black |
| 0.33 | 01 | Dark grey |
| 0.67 | 10 | Light grey |
| 1.00 | 11 | White |

In this example, an intensity codes near 0.33 would be stored as the binary values 01 in frame buffer and pixel with this values would be displayed as dark grey.

**Q11) State and explain the various attributes of polymer film.**

Options for filling a defined region include a choice between a solid colour or a patterned fill and choices for the particular colours and patterns. These fill options can be applied to polygon regions or to areas defined with curved boundaries, depending on the capabilities of the available package. In addition, areas can be painted using various brush styles, colours, and transparency parameters. Areas are displayed with three basic fill styles: hollow with a colour border, filled with a solid colour, or with a specified pattern or design

setInteriorStyle(fs)

values for the fill-style parameter *fs* include hollow, solid, and pattern. Hollow areas are displayed using only the boundary outline, with the interior colour the same as the background colour.

A solid fill is displayed in a single colour up to and including the borders of the region. The colour for a solid interior or for a hollow area outline is chosen with

setInteriorColourIndex(fc)

where fill-colour parameter fc is set to the desired colour code. We select fill patterns with

setInteriorStyleIndex(pi)

where pattern index parameter pi specifies a table position.

When a colour array cp is to be applied to a region, we need to specify the size of the area that is to be covered by each element of the array. We do this by setting the rectangular coordinate extents of the pattern:

setpatternsize (dx, dy)

where parameters *dx* and *dy* give the coordinate width and height of the array mapping.

A reference position for starting a pattern fill is assigned with the statement

setPatternReferencePoint(position)

Parameter *position* is a pointer to coordinates (xp, yp) that fix the lower left comer of the rectangular pattern.

**Q12) How are pattern fills implemented on polygons?**

Areas are displayed with three basic fill styles: hollow with a colour border, filled with a solid colour, or Wed with a specified pattern or design. A basic fill style is selected in a PHIGS program with the function:

setInteriorStyle(fs)

Values for the fill-style parameter fs include hollow, solid, and pattern. Another value for fill style is hatch, which is used to fill an area with selected hatching patterns-parallel lines or crossed lines. The colour for a solid interior or for a hollow area outline is chosen with:

setInteriorColorIndex(fc)

where fill-colour parameter fc is set to the desired colour code. A polygon hollow fill is generated with a line drawing routine as a closed poly-line. These attributes are set independently of the fill style or fill colour, and they provide for the same options as the line-attribute parameters (line type, line width, and line colour).

**Q13) Identify various character attributes with examples.**

There is the choice of font (or typeface), which is a set of characters with a particular design style The characters in a selected font can also be displayed with assorted underlining styles, in boldface, in italics and in outline or shadow styles A particular font and associated style is selected by:

setTextFont(tf)

Colour settings for displayed text are stored in the system attribute list and used by the procedures that control text colour is managed from an application program with:

setTextColorIndex(tc)

where text-colour parameter *tc* specified an allowable colour code.

Text size can be adjusted without changing the width to height ration of characters with:

setCharacterHeight(ch)

The width only of text can be set with the function:

setCharacterExpansionFactor(cw)

where the character width parameter *cw* is set to a positive real value that scales the body with of characters.

Spacing between characters is controlled separately with

setCharacterSpacing(cs)

The orientation for a displayed character string is set according to the direction of the character up vector:

setCharacterUpVector(upvect)

Parameter *upvect* in this function is assigned to values that specify the x and y vector components.

An attribute parameter for arranging character strings vertically or horizontally is set by

setTextPath(tp)

where text path parameter *tp* can be assigned the value: left, right, up or down

Alignment attributes are set with

setTextAlignment(h,v)

where parameters *h* and *v* control horizontal and vertical alignment.

A precision specification for text display is given with:

setTextPrecision(tpr)

where text precision parameter *tpr* is assigned one of the values: string, char or stroke.

**Q14) What are bundled attributes?**

Individual attribute commands provide a simple and direct method for specifying attributes when, a single output device is used. When several kinds of output devices are available at a graphics installation, it is convenient for a user to be able to say how attributes are to be interpreted on each of the different de- vices. This is accomplis1ic.d by setting up tables for each output device that lists sets of attribute values that are to be used on that device, to display each primitive type. A particular set of attribute values tor a primitive on each output device is then chosen by specifying the appropriate table index. Attributes specified in this manner are called bundled attributes.

**Q15) Define anti-aliasing.**

Displayed primitives generated by the raster algorithms have a jagged, or stair-step, appearance because the sampling process digitizes co- ordinate pints on an object to discrete integer pixel positions. This distortion of information due to low-frequency sampling (under-sampling) is called aliasing. We can improve the appearance of displayed raster lines by applying anti-aliasing methods that compensate for the under-sampling process.

A straightforward anti-aliasing method is to increase sampling rate by treating the screen as if it were covered with a finer grid than is actually available. We can then use multiple sample points across this finer grid to determine an appropriate intensity level for each screen pixel. This technique of sampling object characteristics at a high resolution and displaying the results at a lower resolution is called super-sampling (or post-filtering, since the general method involves computing intensities, it sub-pixel grid positions, then combining the results to obtain the pixel intensities).

An alternative to super-sampling is to determine pixel intensity by calculating the areas of overlap of each pixel with the objects to be displayed. Anti-aliasing by computing overlap areas is referred to as area sampling (or pre-filtering, since the intensity of the pixel as a whole is determined without calculating sub-pixel intensities).

**Q16) How does super-sampling method of anti-aliasing work?**

To avoid losing information from such periodic objects, we need to set the sampling frequency to at least twice that of the highest frequency occurring in the object, referred to as the Nyquist sampling frequency.

Super-sampling works by increasing sampling rate by treating the screen as if it were covered with a finer grid than is actually available. We can then use multiple sample points across this finer grid to determine an appropriate intensity level for each screen pixel. This technique samples object characteristics at a high resolution and displaying the results at a lower.

**Q17) What does soft film and pixel phasing mean?**

Soft-fill procedures provide a new fill colour for a region that has the same variations as the previous fill colour. One example of this approach is the linear soft-fill algorithm that assumes that the previous fill was a linear combination of foreground and background colours. This same linear relationship is then determined from the frame-buffer settings and used to repaint the area in a new colour.

Pixel phasing can be used to anti-alias objects on raster systems that can address sub pixel positions within the screen grid. Stair-steps along a line path or object boundary are smoothed out by moving (micro positioning) the electron beam to more nearly approximate positions specific by the object geometry. Systems incorporating this technique are designed so that individual pixel positions can be shifted by a fraction of a pixel diameter. The electron beam is typically shifted by 1/4, 1/2, or 3/4 of a pixel diameter to plot points closer to the true path of a line or object edge. Some systems also allow the size of individual pixels to be adjusted as an additional means for distributing intensities.