
RGPVNOTES.IN

Program : **B.Tech**

Subject Name: **Computer Graphics & Multimedia**

Subject Code: **IT-601**

Semester: **6th**

**Department of Information Technology**

**Subject Name:** Computer Graphics and Multimedia **Subject Code: IT 601**

**Subject Notes**

**Syllabus:**

Introduction to Raster scan displays, Storage tube displays, refreshing, flickering, interlacing, colour monitors, display processors, resolution, working principle of dot matrix, inkjet laser printers, working principles of keyboard, mouse, scanner, digitizing camera, track ball, tablets and joysticks, graphical input techniques: positioning techniques, rubber band techniques, dragging etc.

---

**Course Objectives:**

To introduce the principles of computer graphics and the components of a graphics system.

---

**Unit-I**

**Computer Graphics:**

The computer graphics is one of the most effective and commonly used ways to communicate the processed information to the users. The term computer graphics includes almost everything on computers that is not text or sound. Today almost every computer can do some graphics, and people have even come to expect to control their computer through icons and pictures rather than just by typing. In computer graphics we draw picture on computers also called rendering.

The pictures can be photographs, drawings, movies, or simulations - pictures of things, which do not yet exist and maybe could never exist. Or they may be pictures from places we cannot see directly, such as medical images from inside your body. We spend much of our time improving the way computer pictures can simulate real world scenes.

We want images on computers to not just look more realistic, but also to be more realistic in their colors, the way objects and rooms are lighted, and the way different materials appear. We call this work “realistic image synthesis”.

**Application of Computer Graphics:**

- Computer-aided design for engineering and architectural systems etc.
- Presentation graphics
- Medical applications
- Office automation and desktop publishing
- Computer art and entertainment
- Education and training
- Visualization and image processing
- Graphical user interface
- Education and training
- Cartography

**There are two techniques for producing images on the CRT screen:**

1. Raster scan display
2. Random scan / Vector scan display

**Introduction to Raster Scan Display:**

This is the most common method of drawing images on the CRT screen. In this method horizontal and vertical deflection signals are generated to move the beam all over the screen in a pattern as shown in figure i.e. the electron beam is swept across the screen one row at a time from top to bottom.

Here the beam is swept back and forth from left to right across the screen. When the beam is moved from left to right it is ON. The beam is OFF when it moves from right to left and is called as Horizontal Retrace and is shown by dotted lines.
When the beam reaches the bottom of the screen it is turned off and is rapidly retraced back to the top to start again. This is called the Vertical Retrace. In the Raster Scan display the screen image is maintained by repeating scanning of the same image. The process is shown as Refreshing of screen.

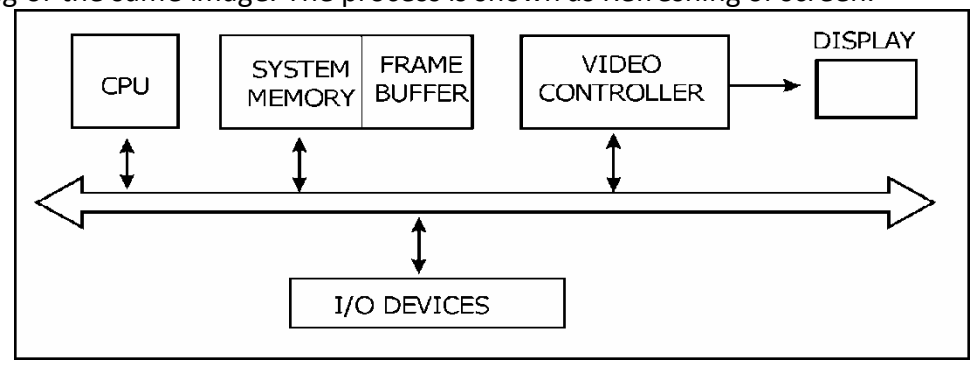



**Figure 1.1 Internal operations of raster scan displays**

Picture definition is stored in a memory area called Refresh buffer or Frame Buffer for which a fined area of the system memory is kept reserved. The frame buffer holds the set of intensity values for all the screen points. Stored intensity values are then retrieved from the refresh buffer and displayed on the screen one row at a time. Video controller has direct access to memory locations in the frame buffer. It is responsible for retrieving data from the frame buffer and passing it to the display device.
Frame buffer maps the screen into Cartesian co-ordinates. Generally, the screen co- ordinates are taken as positive (x, y) plane. Hence the screen is continuously refreshed by scanning from maximum value of y-coordinate down to y = 0.
**Random scan display** directly traces out only the desired lines on the CRT tube i.e. a CRT has the electron beam directed only to the parts of the screen where a picture is to be drawn. Random scan monitors draws a picture one line at a time and for this reason is also known as random scan displays.
If we want a line connecting point A with B on the vector graphics display, we simply drive the beam deflection circuiting, which will cause the beam to go directly from point A to B. If we want to move the beam from point A to point B without showing a line between points, we can blank the beam as we move it.

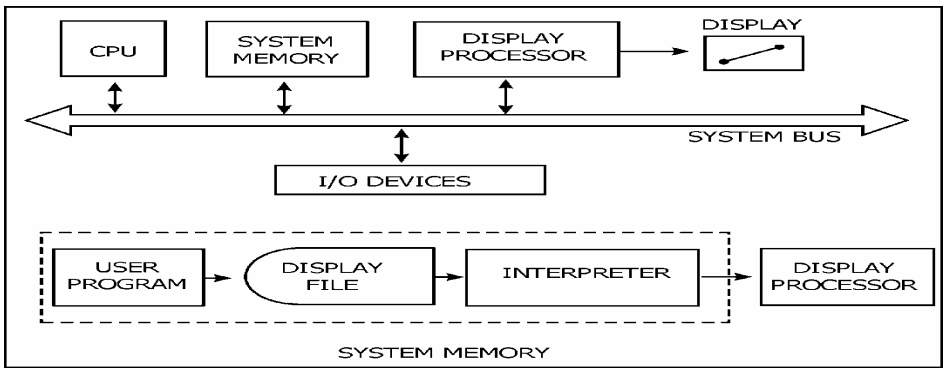



**Figure 1.2 Internal operations of random scan displays**

An application program along with graphics package is present in the system memory. The graphic commands are the program and translated by the graphics package and stored in the display file. In other

records the file used to store the commands necessary for drawing the line segments is called the Display file.

The program which converts these commands into actual picture is called the Display File Interpreter. It is an interface between the graphics representation in the display file and display device. The display processor is connected to the display device, processes and manages the display process.

The commands present in the display file contain two fields, an operation code (opcode) and operands. Opcode identifies the commands such as line draw, move cursors, etc and the operands provide the co-ordinate of a point to process the commands.

One of the ways to store opcode and operands of series of commands is to use to separate arrays, one for opcode, and one for x-coordinate and one for y-co-ordinate of the operand. It is also necessary to assign meanings to the possible opcodes before we can proceed to interpret them.

**Distinguish between Raster & Random Scan Displays:**

| RASTER SCAN DISPLAY | RANDOM SCAN DISPLAY |
|---|---|
| a) It draws the image by scanning one row at a time | a) It draws the image by directing the electron beam directly to the part of the screen where the image is to be drawn. |
| b) Refresh rate is independent of picture complexity. | b) Refresh rate directly depends on picture complexity. |
| c) It produces jagged lines that are plotted as discrete point sets. | c) Smooth lines are displayed because CRT beam directly follows line path. |
| d) They are more suited to geometric area drawing applications e.g. Monitors, Tele vision | d) They are more suited to line drawing application e.g. CRO, pen plotter. |
| e) Raster scan displays have less resolution. | e) Random scan displays have high resolution since picture definition is stored as a set of line drawing commands not as a set of intensity values. |
| f) Editing is easy. | f) Editing is difficult. |

**Cathode Ray Tube (CRT):**

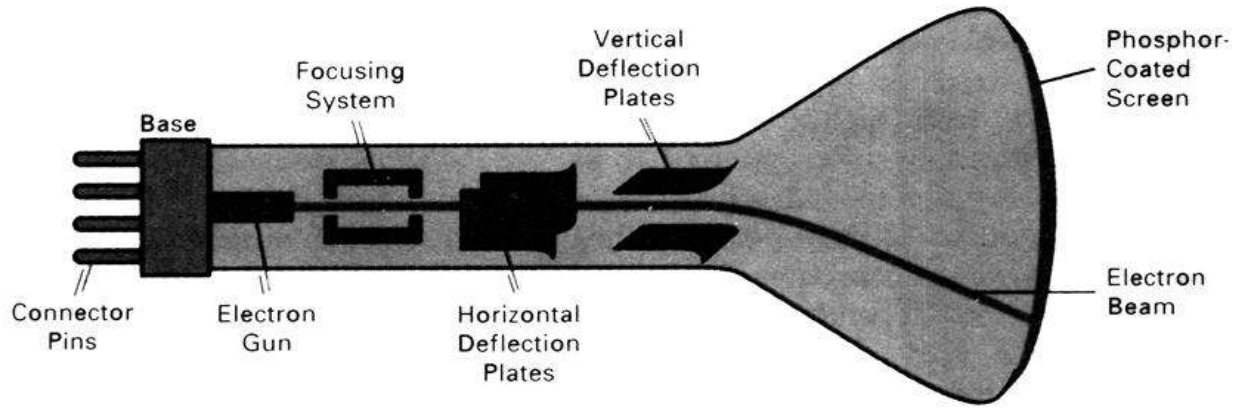



**Figure 1.3 Electrostatic deflection of the electron beam in a CRT**

**Basic Operation:**

A beam of electrons (i.e. cathode rays) is emitted by the electron gun, it passes through focusing and deflection systems that direct the beam towards the specified position on the phosphor screen. The phosphor then emits a small spot of light at every position contacted by the electron beam. Since light emitted by the phosphor fades very quickly some method is needed for maintaining the screen picture. One of the simplest ways to maintain pictures on the screen is to redraw the image rapidly. This type of display is called Refresh CRT.

**Primary components of CRT are as follows: -**

**1. Heating element and cathode**

Heat is supplied to the cathode by passing current through heater element. Cathode is cylindrical metallic structure which is rich in electrons. On heating the electrons are released from cathode surface.

**2. Control grids**

It is the next element which follows cathode. It almost covers cathode leaving small opening for electrons to come out. Intensity of the electron beam is controlled by setting voltage levels on the control grid. A high negative cottage applied to the control grid will shut off the beam by repelling electrons and stopping them from passing through the small hole at the end of control grid structure. A smaller negative voltage on the control grid will simply decrease the number of electrons passing through. Thus, we can control the brightness of a display by varying the voltage on the control grid.

**3. Accelerating anode**

They are positively charged anodes who accelerate the electrons towards phosphor screen.

**4. Focusing & deflection coils**

They are together needed to force the electron beam to converge into a small spot as it strikes the screen otherwise the electrons would repel each other and the beam would spread out as it approaches the screen. Electrostatic focusing is commonly used in television and computer graphics monitor.

**5. Phosphor Coating**

When the accelerating electron beam (collides) is incident on the phosphor cooling, a part of Kinetic Energy is converted into light and heat. When the electrons in the beam collide with the phosphor coating they are stopped and their kinetic energy is absorbed by the phosphor.

**Storage tube displays:**

Conceptually the Direct View Storage Tube (DVST) behaves like a CRT with highly persistent phosphor. Pictures drawn on there will be seen for several minutes (40-50 minutes) before fading. It is similar to CRT as far as the electronic gun and phosphor-coated mechanisms are concerned. But instead of the electron beam directly writing the pictures on the phosphor coated CRT screen, the writing is done with the help of a fine-mesh wire grid.

The grid made of very thin, high quality wire, is located with a dielectric and is mounted just before the screen on the path of the electron beam from the gun. A pattern of positive charges is deposited on the grid and this pattern is transferred to the phosphor coated CRT by a continuous flood of electrons. This flood of electrons is produced by a "flood gun" (This is separate frame the electron gun that produces the main electron beam).

Just behind the storage mesh is a second grid called the collector. The function of the collector is to smooth out the flow of flood electrons. Since a large number of electrons are produced at high velocity by the flood gun, the collector grid, which is also negatively charged reduces, the acceleration on these electrons and the resulting low velocity flood pass through the collector and get attracted by the positively charged portions of the storage mesh (Since the electrons are negatively charged), but are repelled by the other portions of the mesh which are negatively charged (Note that the pattern of positive charges residing on the storage mesh actually defines the picture to be displayed).

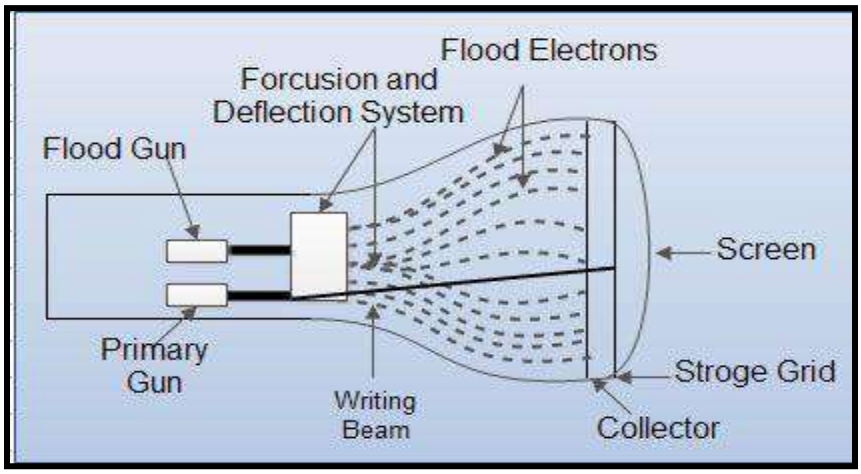



**Figure 1.4 Storage Tube display**

Thus, the electrons attracted by the positive charges pass through the mesh, travel on to the phosphor coated screen and display the picture. Since the collector has slowed the electrons down, they may not be able to produce sharp and bright images. To overcome this problem, the screen itself is maintained at a high positive potential by means of a voltage applied to a thin aluminium coating between the tube face and the phosphor.

The dotted circle on the mesh is created by positive charges the flood of electrons hit the mesh at all points. But only those electrons that hit the dotted circle pass through and hit the CRT screen. The negatively charged mesh repels others.

Since the phosphor is of a very high persistence quality, the picture created on the CRT screen will be visible for several minutes without the need for being refreshed.

Now the problem arises as to how we remove the picture, when the time for its erasure or modification comes up. The simple method is to apply a positive charge to the negatively charged mesh so that it gets neutralized. This removes all charges and clears the screen. But this technique also produces a momentary flash, which may be unpleasant to the viewer.

This is mainly so when only portions of the picture are to be modified in an interactive manner. Also, since the electrons hit the CRT screen at very low speeds (though they are slightly accelerated in the last part of their journey to the CRT by a positively charged aluminium coating), the contrasts are not sharp. Also, even though the pictures stay for almost an hour, there will be a gradual degradation because of the accumulation of the background glow.

The other popular display device is the plasma panel device, which is partly similar to the DVST in principle, but over comes some of the undesirable features of the DVST.

**Advantage:**

a. Refreshing of CRT is not required.
b. Very complex pictures can be displayed at a very high resolution without flicker.

**Disadvantage:**

a. They do not display colors.
b. Selective or part erasing of screen is not possible.

**Some basic definitions:**

**Pixel:** The pixel is the smallest addressable screen element. It is the smallest piece of the display screen which we can control. The control is achieved by setting the intensity and color of the pixel which compose the screen

**Frame buffer:** Picture definition is stored in a memory area called the frame buffer. This frame buffer stores the intensity values for all the screen points.

**Persistence:** The major difference between phosphors is their persistence. It defines how long they continue to emit light after the electron beam is removed.

**Horizontal retrace**: The return to the left of the screen after refreshing each scan line.

**Vertical retrace**: After the end of each frame the electron beam returns to the top left corner of the screen.

**Resolution**: The maximum number of points that can be displayed on the screen.

**Aspect ratio**: The ratio of vertical points to the number of points present in the horizontal line. An aspect ratio of 4/5 means that a vertical line plotted with four points has the same length as a horizontal line plotted with five points.

**Aliasing:** In a line drawing algorithm, we have seen that all rasterized locations do not match with the true line and we have to select the optimum raster locations to represent a straight line. This problem is severe in low resolution screen.

**1. Staircase** A common example of aliasing effects is the staircase of jagged appearance, we see when scan converting a primitive such as a line of a circle. We also see the stair steps of jaggiest along the border of a filled region.

**2. Unequal Brightness** Another side effect that is less noticeable is the unequal brightness of lines of different orientation. A slanted line appears dimmer than a horizontal of vertical line although all are presented at the same intensity level. The horizontal line is placed one unit apart, whereas those on the diagonal line are approximately 1.414 units apart. This difference in density produces the perceived difference in brightness.

**3. Picket Fence Problem** The picket fence problem occurs when an object is not aligned with of does not fit into the pixel grid properly. In the picket fence the distance between two adjacent pickets is not a multiple of the unit distance between pixels. Scan converting it normally into the image space will result in uneven distances between pickets since the endpoints will have to be snapped to pixel coordinates.

**Refreshing:** Refreshing is to redraw the image information from memory . Computer displays(Screen) have to be refreshed because they don't have the capacity to hold a stable image. Electron guns in the cathode ray tube (CRT) constantly sweep across the screen, redrawing the display. The RAMDAC (random access memory digital-to-analog converter) in the graphics card determines a refresh rate : how many times per second the information will be drawn and the image repainted. At adequate refresh rate levels, a display appears stable, but if a refresh rate is too low a display will flicker and can cause eye strain and headaches.

**Flickering:** When the resolution is decaying by the 1/10th of its original resolution the phenomenon whereby a display screen appears to flicker. Screen flicker results from a variety of factors, the most important of which is the monitor's refresh rate, the speed with which the screen is redrawn. If the refresh rate is too slow, the screen will appear to glimmer. Another factor that affects screen flicker is the persistence of the screen phosphors. Low-persistence phosphors fade more quickly than high-persistence monitors, making screen flicker more likely. Screen flicker can also be affected by lighting. Finally, screen flicker is a subjective perception that affects people differently. Some people perceive screen flicker where others do not.

**Interlacing:** In a standard television-like computer monitor, an image is produced on the screen by a beam of electrons sweeping rapidly across the surface of the picture tube, lighting up the screen as it passes. Starting at the top, the beam traces one horizontal row across the screen, shifts down a bit and does another row, and so on, until the full height of the screen has been covered.

In an interlaced monitor, the electron beam takes two passes to form a complete image: it skips every other row on the first pass, and then goes back and fills in the missing rows. A non-interlaced monitor does the whole job in one pass, tracing each row consecutively. Interlaced monitors are easier to build and therefore

cheaper, but as you can guess-they aren't as good as non-interlaced monitors. The problem is that all things being equal, it takes twice as long to create the complete screen image on an interlaced monitor. That's long enough to spoil the illusion that you're looking at a steady picture, and the image on the screen flickers annoyingly.

**Color Monitors (Color Displays):**

There are 2 methods for producing color displays.

A. Beam Penetration technique
B. Shadow Mask technique

**Beam penetration technique:**

This technique is used in Random Scan Monitors. In this technique, the inside of CRT is coated with two layers of phosphor, usually red & green. The displayed color depends on how far the electron beam penetrates into the phosphor layers.

The outer layer is of red phosphor and inner layer is of green phosphor. A beam of slow electrons excites only the outer red layer. A beam of fast electrons penetrates the outer red layer and excites the inner green layer. At intermediate beam speeds, combinations of red and green light are emitted and two additional colors orange and yellow are displayed. The beam acceleration voltage controls the speed of the electrons and hence the screen color at any point on the screen.

**Shadow mask technique:**

The shadow mask technique produces a much wider range of colors than the beam penetration technique. Hence this technique is commonly used in raster scan displays including color T.V. In shadow mask technique, the CRT screen has three phosphor color dots at each pixel position. One phosphor dot emits red light, another emits a green light and the third one emits a blue light. The CRT has three electron guns one for each dot, a shadow mask grid just behind the phosphor coated screen.

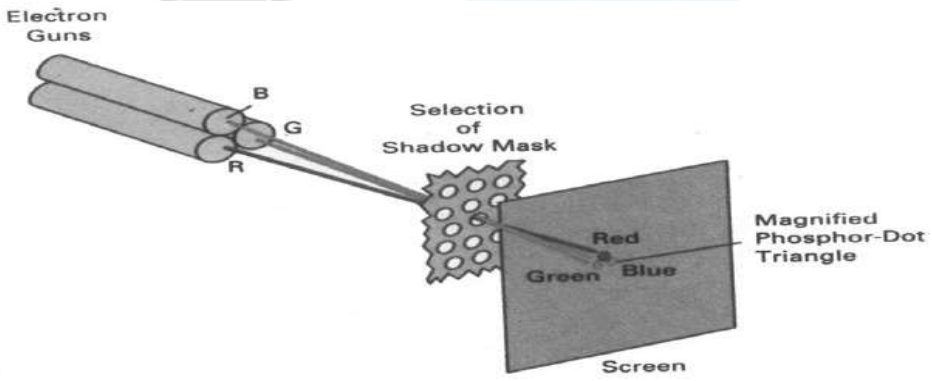



**Figure 1.5 Operations of delta-delta shadow mask method**

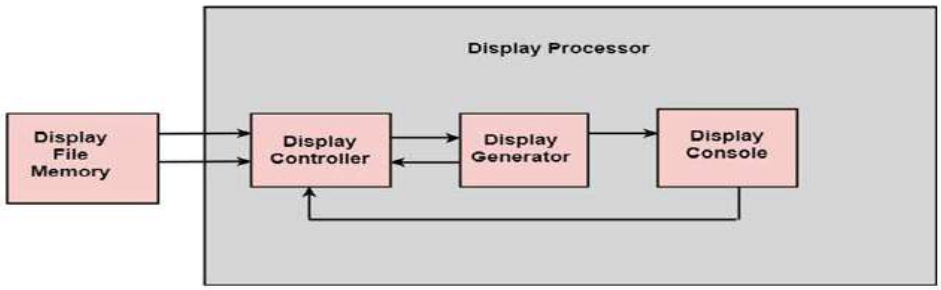
The shadow mask grid consists of series of holes aligned with the phosphor dot patterns. As shown in figure, the three electron beams are deflected and focused as a group onto the shadow mask and when they pass through a hole onto a shadow mask they excite a dot triangle. A dot triangle consists of 3 small phosphor dots of red, green and blue colour. These phosphor dots are arranged so that each electron beam can activate only its corresponding colour dot when it passes through the shadow mask. A dot triangle when activated appears as a small dot on the screen which has colour combination of three small dots in the dot triangle. By varying the intensity of the three electron beams we can obtain different colours in the shadow mask CRT.

**Display Processors:**

It is interpreter or piece of hardware that converts display processor code into pictures. It is one of the four main parts of the display processor:-

**Parts of Display Processor**

1. Display File Memory
2. Display Processor
3. Display Generator
4. Display Console




Block diagram of Display System

**Figure 1.6 Display Processors**

**Display File Memory:** It is used for generation of the picture. It is used for identification of graphic entities.

**Display Controller:**

1. It handles interrupt
2. It maintains timings
3. It is used for interpretation of instruction.

**Display Generator:**

1. It is used for the generation of character.
2. It is used for the generation of curves.

**Display Console:** It contains CRT, Light Pen, and Keyboard and deflection system.

The raster scan system is a combination of some processing units. It consists of the control processing unit (CPU) and a particular processor called a display controller. Display Controller controls the operation of the display device. It is also called a video controller.

**Working:** The video controller in the output circuitry generates the horizontal and vertical drive signals so that the monitor can sweep. Its beam across the screen during raster scans.

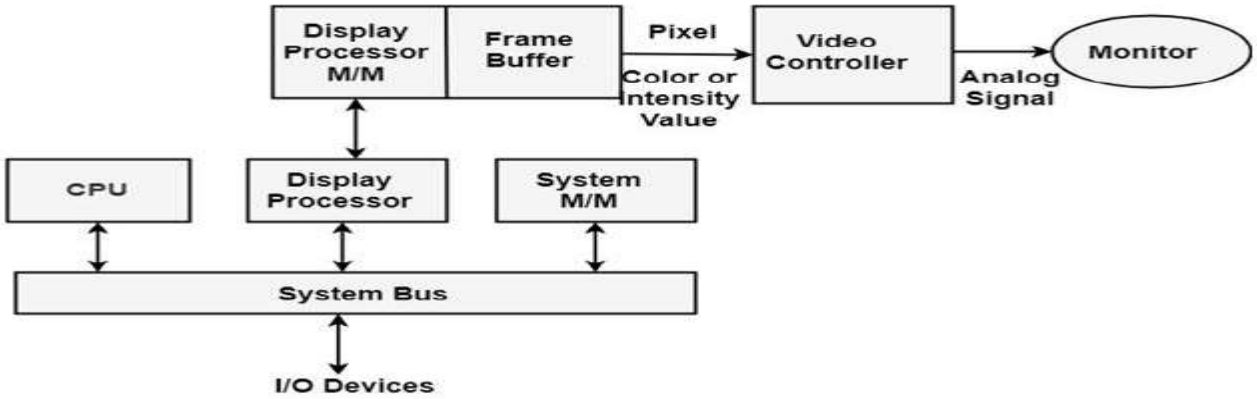



**Figure 1.7 Architecture of Raster Display System**

As figure 1.7 showing that 2 registers (X register and Y register) are used to store the coordinate of the screen pixels. Assume that y values of the adjacent scan lines increased by 1 in an upward direction starting from 0 at the bottom of the screen to $y_{max}$ at the top and along each scan line the screen pixel positions or x values are incremented by 1 from 0 at the leftmost position to $x_{max}$ at the rightmost position.The origin is at the lowest left corner of the screen as in a standard Cartesian coordinate system.

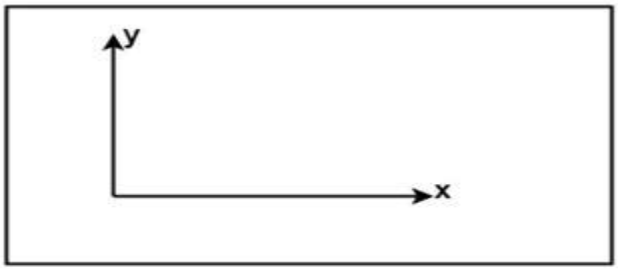



**Figure 1.8 Origin of the Coordinates System**

**At the start of a Refresh Cycle:**

X register is set to 0 and y register is set to $y_{max}$. This (x, y') address is translated into a memory address of frame buffer where the color value for this pixel position is stored. The controller receives this color value (a binary no) from the frame buffer, breaks it up into three parts and sends each element to a separate Digital-to-Analog Converter (DAC).

These voltages, in turn, controls the intensity of 3 e-beam that are focused at the (x, y) screen position by the horizontal and vertical drive signals. This process is repeated for each pixel along the top scan line, each time incrementing the X register by Y. As pixels on the first scan line are generated, the X register is incremented through$x_{max}$, then x register is reset to 0, and y register is decremented by 1 to access the next scan line.

Pixel along each scan line is then processed, and the procedure is repeated for each successive scan line units pixels on the last scan line (y=0) are generated. For a display system employing a color look-up table frame buffer value is not directly used to control the CRT beam intensity.

It is used as an index to find the three pixel-color value from the look-up table. This lookup operation is done for each pixel on every display cycle. As the time available to display or refresh a single pixel in the screen is too less, accessing the frame buffer every time for reading each pixel intensity value would consume more time what is allowed:

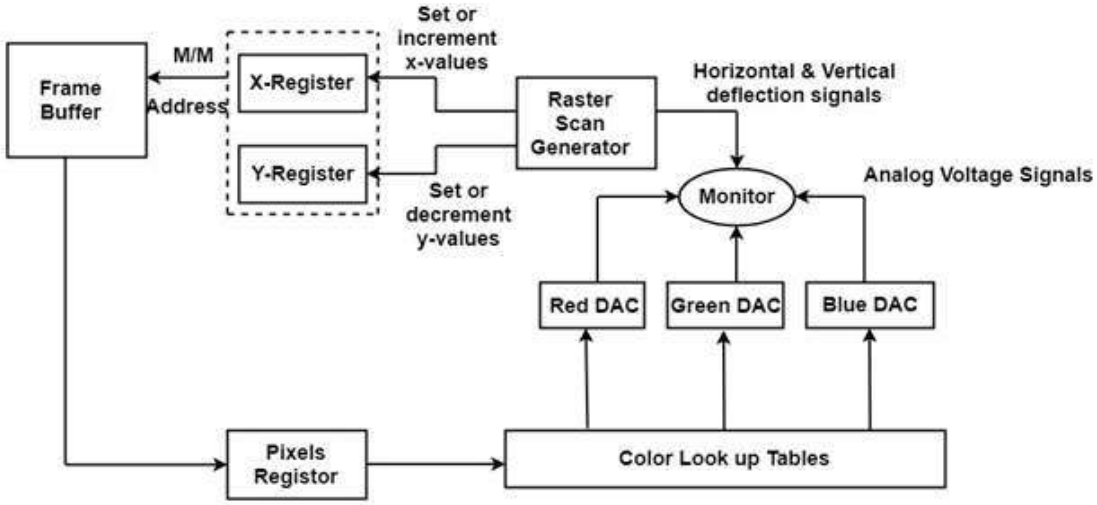



**Figure 1.9 Raster Display Systems**

Multiple adjacent pixel values are fetched to the frame buffer in single access and stored in the register. After every allowable time gap, the one-pixel value is shifted out from the register to control the warm intensity for that pixel. The procedure is repeated with the next block of pixels, and so on, thus the whole group of pixels will be processed.

**Resolution**

The resolution can be defined in many ways. Such as pixel resolution, spatial resolution, temporal resolution, spectral resolution. Out of which we are going to discuss pixel resolution. You have probably seen that in your own computer settings, you have monitor resolution of 800 x 600, 640 x 480 etc. In pixel resolution, the term resolution refers to the total number of count of pixels in an digital image. For example. If an image has M rows and N columns, then its resolution can be defined as M X N. If we define resolution as the total number of pixels, then pixel resolution can be defined with set of two numbers. The first number the width of the picture, or the pixels across columns, and the second number is height of the picture, or the pixels across its width. We can say that the higher is the pixel resolution, the higher is the quality of the image. We can define pixel resolution of an image as 4500 X 5500.

**Megapixels**

We can calculate mega pixels of a camera using pixel resolution.

Column pixels (width) X row pixels (height) / 1 Million.

The size of an image can be defined by its pixel resolution.

Size = pixel resolution X bpp (bits per pixel)

**Calculating the mega pixels of the camera**

Let's say we have an image of dimension: 2500 X 3192.

Its pixel resolution = 2500 * 3192 = 7982350 bytes.

Dividing it by 1 million = 7.9 = 8 mega pixel (approximately).

**Printers:**

**"A printer is an external output device that takes data from a computer and generates output in the form of graphics / text on a paper"**

**Two Types of printers are**:
Impact and Non-Impact Printers are two categories of the printer. Impact printers involve mechanical components for conducting printing. While in Non-Impact printers, no mechanical moving component is used.

**Impact Printers**: It is a type of printer that works by direct contact of an ink ribbon with paper. These printers are typically loud but remain in use today because of their unique ability to function with multipart forms. An impact printer has mechanisms resembling those of a typewriter.
Example of Impact Printers, Dot-matrix printers, Daisy-wheel printers, and line printers.

**Non-Impact Printers**: It is a type of printer that does not hit or impact a ribbon to print. They used laser, xerographic, electrostatic, and chemical and inkjet technologies. Non-impact printers are generally much quieter. They are less likely to need maintenance or repairs than earlier impact printers.
Example of Non-Impact Printers is Inkjet printers and Laser printers.

**Dot Matrix printer:**

Dot matrix printers, also known as impact matrix devices, are an older kind of printer that relies on an ink-soaked ribbon similar to that used in a typewriter. These devices were the most common inexpensive printing option during the 1970s and 1980s, but were largely replaced by laser and inkjet models by the mid-

1990s. However, as of the date of publication, dot matrix printers are still in use for some specialty applications, due to their ability to print quickly even on multi-part documents.

**Working Principle:**

During printing process the print-shuttle vibrates in horizontal direction with high speed while the print hammers are fired selectively. So each hammer may print a series of dots in horizontal direction for one pass of the shuttle, then paper advances at one step and the shuttle prints the following row of dots Line printing process: While print-shuttle vibrates in horizontal direction the print hammers are fired selectively and each hammer prints a series of dots in horizontal direction for one pass of the shuttle, then paper advances at one step and the shuttle prints the following row of dots.

Line matrix printers are the right solutions for high-volume impact printing and are superior in speed, reliability and quality. As price-performance leaders, line printers cost less to service and less to use. The fastest line matrix printers available on the market are Tally T6218 and Printronix P5220, with a claimed print speed between 1800 and 2000 lines per minute (lpm).

**Advantages:**

1.They can print on multi-part stationary or make carbon copies
2. Low printing cost
3. They can bear environmental conditions.
4. Long life

**Disadvantage**

1. Noise
2. Low resolution
3. Very limiter Color performance
4. Low speed



**Inkjet Printer:** - Inkjet printers one of the user friendly computer printers. It works by propelling variably-sized droplets of liquid or molten material (ink) onto almost any medium. They are the most common type of printer for the general consumer due to their low cost, high quality of output, capability of printing in glowing colour, and easy to use and handle.

**Working Principle:**

An inkjet printer is any printer that places extremely small droplets of ink onto paper to create an image. If you ever look at a piece of paper that has come out of an inkjet printer, you know that:

• The dots are extremely small (usually between 50 and 60 microns in diameter), so small that they are tinier than the diameter of a human hair (70 microns)!
• The dots are positioned very precisely, with resolutions of up to 1440x720 dots per inch (dpi).
• The dots can have different colors combined together to create photo-quality images.

**Advantages:**

1. Low printer cost
2. Compact size
3. Low noise
4. no warm up time compare to laser printer

**Disadvantage**

1. The ink is often very expensive (for a typical OEM cartridge cost RM70 for 16ml, RM4375 per liter)

2. Lifetime of inkjet prints produced by inkjet printer is limited. They will eventually fade and the color balance may change.
3. Easy get “blur” if get water drop.
4. Easy to get clogging on inkjet nozzles.
5. Must print it once every few days. Make sure print head won’t dried up.

**Input Devices:**

Following are the commonly used input devices

1. Keyboard
2. Mouse
3. Scanner
4. Trackball / Space ball
5. Joystick
6. Digitizer / Graphical tablet
7. Digitizing Camera

**1. Keyboard:**

Keyboard is the primary input device for any graphics system. It is used for entering text and numbers. Keyboards are available in various sizes, shapes & styles. The standard keyboard consists of

a. Alphanumeric keys
b. Function keys
c. Modifier keys
d. Cursor Movement keys
e. Numeric Keypad

When we press a key on the keyboard, the keyboard controller places a code corresponding to the key pressed, in a part of its memory called keyboard buffer. This code is called the scan code. The keyboard controller informs the CPU of the computer about the key pressed with the help of interrupt signals. The CPU then reads the scan code from the Keyboard Buffer.

**Working Principle of a Keyboard:-** Inside the keyboard, there are metallic plate, circuit board and processor, which are responsible for transferring information from the keyboard to the computer. Depending upon the working principle, there are two main types of keys, namely, capacitive and hard-contact. Let's discuss in brief about the functioning of capacitive and hard contact key. When a capacitive key is pressed, the metal plunger applies a gentle pressure to the circuit board. The pressure is identified by the computer and the circuit flow is initiated, resulting in the transfer of information from the circuit to the currently installed software.

The key identifying to computer is identified using a keyboard driver and finding the preferred key called Source code.

**2. Mouse:**

A mouse is a palm sized box used to position the screen cursor. It consists of a ball on the bottom connected to wheels to provide the amount and direction of movement. One, two or three buttons are usually included on the top of the mouse for signaling the execution of same operation. Now-a-days mouse consists of one more wheel on top to scroll the screen pages.

**Working Principle of a Mouse:-** The primary mechanical part of a mouse is a ball on the bottom of the mouse. There are these little wheels which turn/rotate when the ball moves against them. The wheels are monitored electronically. When they turn or rotate they transmit how much they have turned to the computer. Out of

these three wheels the two wheels perpendicular to each other are used for tracking the motion on X-axis and Y-axis. The third one just balances the two.

When the mouse is moved on a flat surface the roller ball moves in the locking ring. When the mouse is positioned on the desktop the actuators register the mouse balls movement in X-axis and Y-axis direction. The sensors attached to it generate a series of pulses representing movement on both axis. The pulse generated is in same ratio as the mouse movements i.e. more pulse mean more movement.

Normally a mouse is used along with a mouse pad. Place the mouse pad on a flat surface and place the mouse on it. Move the mouse pad and the pointer moves in the direction of the movement of mouse.

**3. Track Ball & Space-ball:**

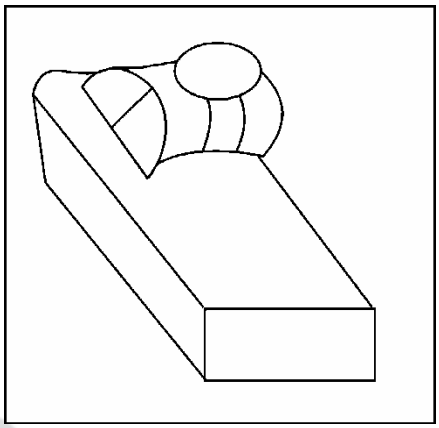


**Figure 1.10 Operations of track ball**

A trackball is a ball that can be rotated with the finger or palm of the hand to produce the screen cursor movement. Potentiometers attached to the ball measure the amount and direction of rotation.

While the trackball is used for 2D positioning, the space ball is used for 3D positioning & selection of operation in virtual reality system unlike the trackball the space ball does not actually move. It consists of strain gauges which measures the amount of pressure applied to the space ball to provide input for spatial positioning & orientation of the ball is pushed a pulled in various directions.

**Working Principle of Trackball:**

The trackball is used for similar purposes as the mouse. Its internal design is almost identical to a mouse and can be regarded as a mouse on its back and left in a stationary position. The trackball pre-dates the mouse and it is popularly believed that the mouse was conceived by turning a trackball upside down and moving it across a table surface. A metal or plastic ball is mounted in a frame, with only a small portion protruding through the opening in the top of the frame. The ball is supported by two perpendicular rods so that when the ball is rotated left or right, one rod rotates, and when it is rotated forward or backward, the other rod rotates.

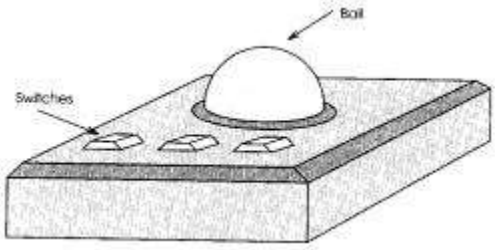



**Figure 1.11 Trackball**

The ball is completely free to rotate within its socket. It is operated by the palm of the hand and the movements sensed by the ball being in contact with two rollers inside the casing in the same manner as a mechanical mouse. The rollers' movements again are detected by sensing the rotations of discs attached to their ends. This sensing can be achieved by electrical contacts or by LEDs and photo detectors. Like the mouse, a trackball unit will usually include some buttons which can be reached by the tips of the fingers while the palm of the hand is resting on the ball. For most purposes the mouse is more popular than the trackball but in situations where space is tight or no suitable surface is available the trackball is used. Currently it is commonly integrated into the casing of most laptop personal computers.

**4. Scanners:**

Scanner has become an important part of the home, office over the last few years. It is a device which can be used to store drawings, graphics, and photos as text available in the printed form for computer processing.

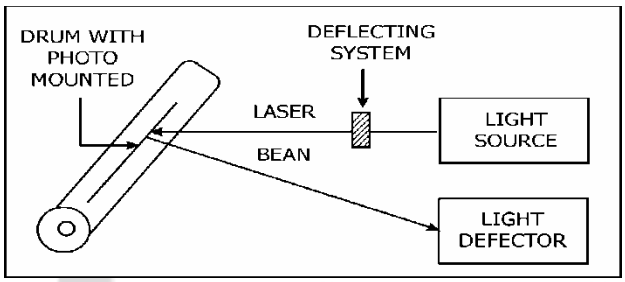



**Figure 1.12 Working of Scanners**

As shown in the figure the photograph is mounted on a rotating drum. A finely collimated light beam is directed at the photo, and the amount of light reflected is measured by a photocell. As the drum rotates the light source slowly moves from one end to the other, thus doing a raster scan of the inter photograph.

**Working Principle of a Scanner:-** All scanners work on the same principle of reflectance or transmission. The image is placed before the carriage, consisting of a light source and sensor; in the case of a digital camera, the light source could be the sun or artificial lights. When desktop scanners were first introduced, many manufacturers used fluorescent bulbs as light sources. While good enough for many purposes, fluorescent bulbs have two distinct weaknesses: they rarely emit consistent white light for long, and while they're on they emit heat which can distort the other optical components. For these reasons, most manufacturers have moved to cold-cathode bulbs. These differ from standard fluorescent bulbs in that they have no filament. They therefore operate at much lower temperatures and, as a consequence, are more reliable. Standard fluorescent bulbs are now found primarily on low-cost units and older models.

**5. Joysticks:**

A joystick has a small vertical lever mounted on the base and used to steer the screen cursor around. It consists of two potentiometers attached to a single liver. Moving the liver changes the settings on the potentiometer. The left or right movement is indicated by other one potentiometer & the forward or backward movement is indicated by another potentiometer. Thus, with a position can be simultaneously altered by the motion of a single lever.

Some joysticks may return to this zero (centre) positions when released. Joysticks are inexpressive and quiet commonly used where only rough positioning is needed.

**Working principle of Joystick:** The working of joystick is simple. It is based on the principle of conversion of physical movement into a digital signal which when accepted by the device produce same results on the screen. The joystick starts working only when it is connected to the computer or the gaming device. While playing the game, every time the user makes a movement on the joystick, the wires in the device connects a circuit with one another and the computer to produce the same movement in the virtual body in the game or the application.

**6. Digitizer or Graphical Tablet:**

For applications such as tracing we need a device called a Digitizer or Graphical Tablet. It consists of a flat surface, ranging in size from about 6 x 6 inches up to 48 to 72 inches or more, which can direct the position of a movable style.

In this arrangement, a grid of wires is embedded in the tablet surface. Electromagnetic signals generated by electrical pulses applied in sequence to the wires in the grid induce an electrical signal in a wire cod in the styles. The strength of the signal induced by each pulse is used to determine the position of the styles.

**Working principle of Tablet:** The tablet cores to be film coated make continual orbital motions within the closed rotating drum under the action of a streamlined guide plate. During the motion, coating medium automatically sprays according to the technological process and rational technological parameters, at the same time hot air is supplied under a negative pressure. The hot air penetrates through the tablet core layers and is discharged from the bottom of the layers, so that the coating medium sprayed on the surface will dry rapidly and evenly, thus forming a solid and smooth surface film.

**7 . Digitizing camera**

A digitizing camera is a hardware device that takes photographs and stores the image as data on a memory card. Unlike an analog camera, which exposes the chemicals on film to light, a digital camera uses digital optical components to register the intensity and color of light, and converts it into pixel data. Many digital cameras are capable of recording video in addition to taking photos.

**Working principle of a digitizing camera:**

- **Capturing image:** lenses focused the light rays come from the object made into a coherent image. Diaphragm determines amount of light to be entered and shutter speed determines time of exposure. Then lights made fall onto sensor (CCD) to get corresponding electric charge.
- **Binary system processing:** Where there is word digital, the word binary also found there. To convert analogue signal (electric charge from photosites) to Digital signal in binary form a ADC converter is used. Each of the charge stored in photosites assigns to a binary value, storing them as pixels. A pixel is a point sample of an image which contains three basic color (RGB) components. Pixel per square inches determines the resolution of the camera, which indicates the size and quality of image. In next post I'll discuss more about pixel and resolution.
- **Compression and storage:** Once the image is digitalized, it is compressed by a microprocessor and stores as image file (JPEG, TTF etc.)

**Graphical Input Techniques**

Through the choice of techniques, computer provides the user of the program with a set of commands, called a command language. We use graphical input techniques for the effective use of graphical input device.

**Positioning Techniques**

Locating is known as positioning. The user indicates a position on the screen with an input device and this position is used to insert a symbol or to define the endpoint of a line. The need for positioning occurs in application, where to define new elements of the model or to reposition an existing one.

Positioning involves the user, in first moving the cursor or tracking the cursor to the desired position then press button or key to notifying the computer. In keyboard like device have set of 4 keys may be assigned to stop the cursor horizontally or vertically and fifth key held down.

**Rubber band Techniques**

A rubber band line: The user specifies two end points. As he moves from the first endpoint to the second, the program displays a line form first end point to the cursor position. This effect is of an elastic line stretched between the first endpoint and to the cursor.

**Advantage:**

Rubber –band technique is used for horizontally or vertically constrained lines, rectangle, and arcs of circles. The technique is very helpful in drawing relatively complex entities.

**Disadvantage:**

Rubber band technique needs heavy computation. This line must be redrawn 5 times/sec. If it is less frequently then jerks occur.

If the application program is running on a computer remote from the graphics terminal, it is usually difficult to update the line often enough.

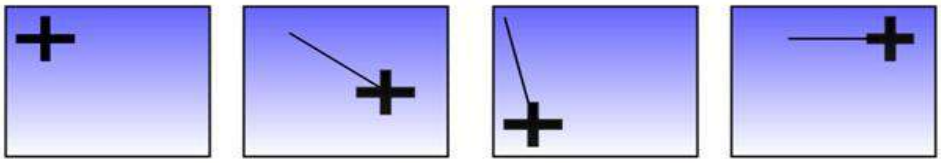


**Figure 1.13 Rubber band Techniques**

**Example:** This is widely followed in MS-Window based Applications like in the case of a paintbrush drawing package.

Other geometric entities can be drawn in a rubber-band fashion:

- Horizontally or vertically constructed lines
- Rectangles
- Arcs of circles

This technique is very helpful in drawing relatively complex entities such as rectangles and arcs.

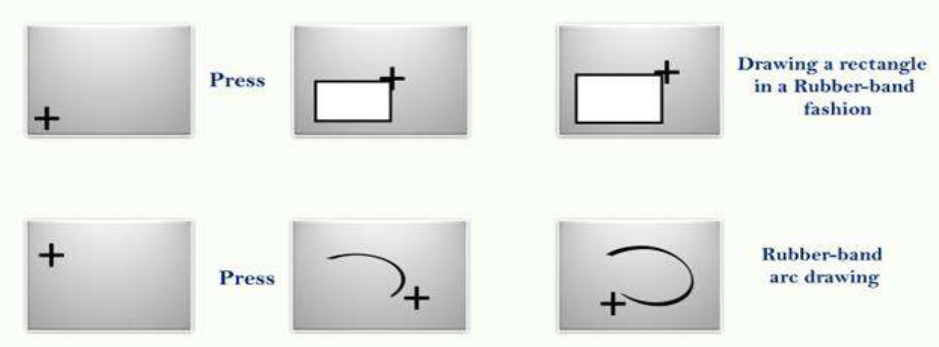



**Figure 1.14 Rubber band Techniques**

**Dragging:**

Dragging is used to move an object from one position to another position on the computer screen. To drag any other object, first, we have to select the object that we want to move on the screen by holding the mouse button down. As cursor moved on the screen, the object is also moved with the cursor position. When the

cursor reached the desired position, the button is released.The following diagram represents the dragging procedure:

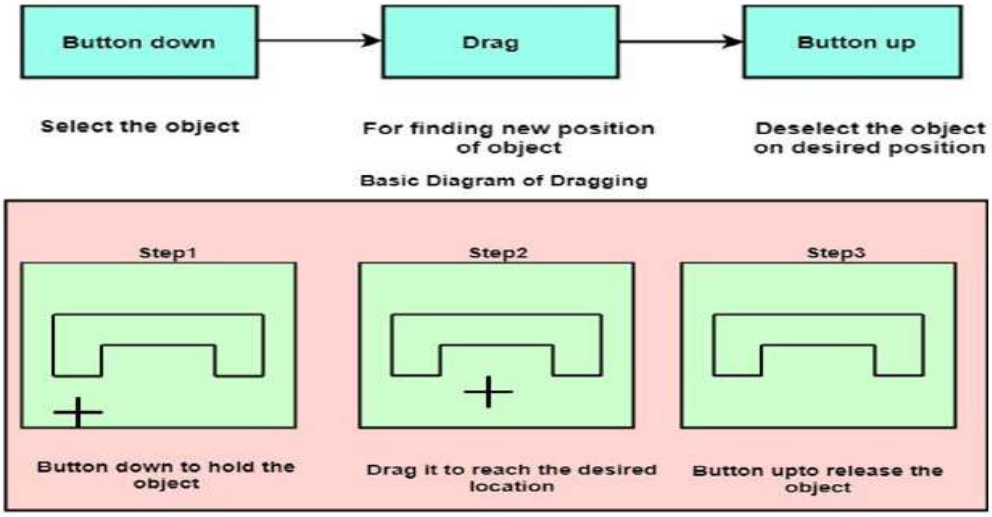



**Figure 1.15 Dragging**


RGPVNOTES.IN

We hope you find these notes useful.

You can get previous year question papers at https://qp.rgpvnotes.in .

If you have any queries or you want to submit your study notes please write us at rgpvnotes.in@gmail.com

LIKE & FOLLOW US ON FACEBOOK
facebook.com/rgpvnotes.in