<u>UNIT 4:</u>

2.1 OUTPUT DEVICES

Any peripheral device used to communicate results of the data processing carried out by computer to outside word is called the output device.

Output of computer on paper is known as hard copy. Printers and plotters are used to get hard copy of the output. Plotters are used to draw large size drawing and are used mainly for architecture and engineering tasks. Therefore, plotters are not discussed in this course.Printers are classified on the basis of its' working principal. Three types of printers have been used frequently in offices i.e. dot matrix, laser and inkjet printers. We will discuss about these printer in short while.

Display Device

A display device is a device for visual or tactile presentation of images (including text)

acquired, stored, or transmitted in various forms.

Ex : Computer monitor, TV screen.

MONITOR

Every computer is connected with a monitor to display information. Monitors are rectangular in shape with aspect ratio of (length to width ratio) 4:3. You must have noticed that most of the pictures in newspapers, books andmagazines are with this aspect ratio. Thus, human feels more comfortable in watching a display with aspect ratio of 4:3. Monitors are available in different sizes like televisions. The size of a monitor is reflecting by the diagonal length of the screen of that monitor. The sizes of monitorsare in the range of 15 to 21 inches. Monitors with size more than 21 inchesare not needed in offices. Another important feature of monitor is the resolution of the monitor. The resolution of monitor is measured by numbers of pixels is the unit area. Pixel can be defined as smallest unit of display that can be control by monitor. The entire screen is made of pixels placed horizontally and vertically. Display in high-resolutionmonitor (More pixels in unit area) is of high quality and attractive. Another important feature of colours can be displayed by a pixel. Monitor with high resolution and more colours are needed when we run highly graphical and multimedia-based application.

Monitor may be based on Cathode Ray Tube (CRT) technology or Thin Film Transistor Liquid Crystal **D**isplay (TFT LCD). Monitor based on Cathode Ray Tube (CRT) technology looks and functions alike a television. A CRT picture tube is used to display information. Electromagnetic rays strike on the front glass of the picture tube to generate display. These rays can be distorted easily by electro-magnetic fields generated by nearby electrical or electronic devices. The electromagnetic field of nearby electrical appliances may generate flickering effect in picture.

RELATED TERMINOLOGIES

- Pixel:
 - Picture Element

It is the smallest element forming an image.

Resolution :

No. of pixels per unit video display

Video Graphics Array (VGA):

720 pixels across by 400 pixels down in text mode

640 pixels across by 480 pixels down in graphics mode.

Display Size:

Measured as distance from one corner to the diagonally opposite corner. Usually measured in INCHES.

Viewing Angle

It is angle from which the screen can be seen from side. It is larger for CRT as compared to LCD

• Response time :

The minimum time necessary to change a pixel's color or brightness.

Brightness:

The amount of light emitted from the display (more specifically known as luminance).

Screen Size:

The actual amount of screen space that is available to display a picture, video or working space Desktop screens are usually 14 - 25 inches by diagonal measurement.



Aspect Ratio:

- The aspect ratio of a display is the fractional relation of the width of the display area compared to its height
- **W** Two common aspect ratio:
 - 4:3 - 16:9



Display Resolution:

- **4** The resolution of a monitor indicates how densely packed the pixels are.
- **4** In general, the more pixels (often expressed in dots per inch), the sharper the image.
- **4** Most modern monitors can display 1024 by 768 pixels, the SVGA standard.
- ↓ Some high-end models can display 1280 by 1024, or even 1600 by 1200.



• Refresh Rate :

- 4 The refresh rate is the number of times in a second that a monitor draws the data.
- \downarrow The refresh rate for a monitor is measured in hertz
- The standard refresh rate is 75Hz, this means that the monitor redraws the display 75 times per second.
- **4** A flickering monitor can contribute to eyestrain and headaches.
- **4** The faster the refresh rate, the less the monitor flickers.
- 4



• Color Depth:

- Color depth describes how many colors that can be displayed on a monitor's screen.
- **4** Common color depths used by monitor:
 - 4-bit (EGA) = 16 colors
 - 8-bit (VGA) = 256 colors
 - 16-bit (High Color) = 65,536 colors
 - 24-bit (True Color) = 16 million colors



Types of Monitor:

- Cathode Ray Tube (CRT)
- Liquid Crystal Display (LCD)
- Light-emitting Diode (LED)

1) What is cathode ray tube?

The cathode ray tube (CRT) is a vacuum tube containing an electron gun (a source of electrons) and a fluorescent screen, with internal or external means to accelerate and deflect the electron beam, used to create images in the form of light emitted from the fluorescent screen.



Features:

The features of a CRT can be split into 4 main sections:

Electron gun:

- The role of this section is to **produce electrons** at a **high, fixed, velocity**.
- This is done through a process known as **thermionic emission**.

Deflection system:

- It consists of **Two PERPENDICULAR sets** of **Electric/Magnetic fields**.
- This allows control over both **horizontal and vertical** axes.
- By controlling the Voltage applied to the fields, it is possible to vary the
- deflection through **Electrostatic force/Motor effect**.

Fluorescent screen.

- The role of this part is to **display** where the electrons are hitting the CRT.
- It is a screen coated with a material that **emits light when struck** by electrons.
- Zinc sulfide or Phosphorus are two commonly used materials.

Glass Tube & Base:

- The whole assembly is protected in a conical highly evacuated glass tube.
- Glass tube is a long, clear tube. The CRT uses an evacuated glass envelope which is large, deep , fairly heavy, and relatively fragile.
- Inside the tube's neck is an assembly that produces a stream of electrons. Electrical connections to these internal components are made through metal pins that extend out through the back of the tube's neck, usually in a circular formation.
- Vacuum is created inside the glass tube 0.001Pa to 133 nPa.
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How CRTs work & display?

 A CRT monitor contains millions of tiny red, green, and blue phosphor dots that glow when struck by an electron beam that travels across the screen to create a visible image. In a CRT monitor tube, the cathode is a heated filament. The heated filament is in a vacuum created inside a glass tube. The electrons are negative and the screen gives a positive charge so the screen glows.

▶



Color CRTs:

- Color tubes use three different phosphors which emit red, green, and blue light respectively.
- Color CRTs have three electron guns, one for each primary color, arranged either in a straight line or in a triangular configuration .
- The three beams in color CRTs would not strike the screen at the same point without convergence calibration.



Aperture Grille v/s Shadow Mask

CRTs incorporate a metal sheet behind the display screen which affects the pixels on the screen as well



as brightness on the screen. **Shadow mask** is an obsolete technology in which there is a metal sheet with millions of holes to pass electrons in order to hit the phosphor coating. The shadow mask covers the entire screen thereby protecting the phosphors from stray ions (due to vacuum) and also limits the strength of the rays reducing the brightness on the monitor.

Aperture grille is a mesh of wires rather than any metal sheet with holes in it. Although the grill is fragile, it allows a brighter display.

Application of Crt:

- In televisions
- In computer monitors
- As a display device in radar
- In cathode ray oscilloscope

Advantages of CRT:

- The cathode rayed tube can easily increase the monitor's brightness by reflecting the light.
- can produce more colours.
- The quality of the image displayed on a CRT monitors is superior to the LCD and Plasma monitors.
- The colour features of the cathode ray tube monitor are considered highly excellent.

Disadvantages of CRT:

- monitors causes a health hazard to the functioning of living cells.
- CRTs emit a small amount of X-ray radiation which can result in a health

hazard.

- Constant refreshing of CRT monitors can result a headache.
- CRTs operate at very high voltage which can overheat system or result in an implosion.

LCD (Liquid Crystal Display)?

- A liquid crystal display or LCD draws its definition from its name itself. It is a combination of two states of matter, the solid and the liquid. LCD uses a liquid crystal to produce a visible image. Liquid crystal displays are super-thin technology display screens that are generally used in laptop computer screens, TVs, cell phones, and portable video games. LCD's technologies allow displays to be much thinner when compared to a cathode ray tube (CRT) technology.
- Liquid crystal display is composed of several layers which include two polarized panel filters and electrodes. LCD technology is used for displaying the image in a notebook or some other electronic devices like mini computers. Light is projected from a lens on a layer of liquid crystal. This combination of colored light with the grayscale image of the crystal (formed as electric current flows through the crystal) forms the colored image. This image is then displayed on the screen.
- An LCD is either made up of an active matrix display grid or a passive display grid. Most of the Smartphone's with LCD technology uses active matrix display, but some of the older displays still make use of the passive display grid designs. Most of the electronic devices mainly depend on liquid crystal display technology for their display. The liquid has a unique advantage of having low power consumption than the LED or cathode ray tube.
- The liquid crystal display screen works on the principle of blocking light rather than emitting light. LCDs require a backlight as they do not emit light them. We always use devices which are made up of LCD's displays which are replacing the use of cathode ray tube. Cathode ray tube draws more power compared to LCDs and is also heavier and bigger.

How LCDs are Constructed?

Simple facts that should be considered while making an LCD:

1. The basic structure of the LCD should be controlled by changing the applied current.

- 2. We must use polarized light.
- 3. The liquid crystal should able be to control both of the operations to transmit or can also able to change the polarized light.



As mentioned above that we need to take two polarized glass pieces filter in the making of the liquid crystal. The glass which does not have a polarized film on the surface of it must be rubbed with a special polymer that will create microscopic grooves on the surface of the polarized glass filter. The grooves must be in the same direction as the polarized film.

Now we have to add a coating of pneumatic liquid phase crystal on one of the polarizing filters of the polarized glass. The microscopic channel causes the first layer molecule to align with filter orientation. When the right angle appears at the first layer piece, we should add a second piece of glass with the polarized film. The first filter will be naturally polarized as the light strikes it at the starting stage.

Thus the light travels through each layer and guided to the next with the help of a molecule. The molecule tends to change its plane of vibration of the light to match its angle. When the light reaches the far end of the liquid crystal substance, it vibrates at the same angle as that of the final layer of the molecule vibrates. The light is allowed to enter into the device only if the second layer of the polarized glass matches with the final layer of the molecule.

How LCDs Work?

1) The principle behind the LCDs is that when an electrical current is applied to the liquid crystal molecule, the molecule tends to untwist. This causes the angle of light which is passing through the molecule of the polarized glass and also causes a change in the angle of the top polarizing filter. As a result, a little light is allowed to pass the polarized glass through a particular area of the LCD.

- 2) Thus that particular area will become dark compared to others. The LCD works on the principle of blocking light. While constructing the LCDs, a reflected mirror is arranged at the back. An electrode plane is made of indium-tin-oxide which is kept on top and a polarized glass with a polarizing film is also added on the bottom of the device. The complete region of the LCD has to be enclosed by a common electrode and above it should be the liquid crystal matter.
- 3) Next comes the second piece of glass with an electrode in the form of the rectangle on the bottom and, on top, another polarizing film. It must be considered that both the pieces are kept at the right angles. When there is no current, the light passes through the front of the LCD it will be reflected by the mirror and bounced back. As the electrode is connected to a battery the current from it will cause the liquid crystals between the common-plane electrode and the electrode shaped like a rectangle to untwist. Thus the light is blocked from passing through. That particular rectangular area appears blank.

How LCD utilizes Liquid Crystals & Polarized Light?

- 1) An LCD TV monitor utilizes the sunglasses concept to operate its colored pixels. On the flip side of the LCD screen, there is a huge bright light that shines out in the direction of the observer. On the front side of the display, it includes the millions of pixels, where each pixel can be made up of smaller regions known as sub-pixels. These are colored with different colors like green, blue, and red. Each pixel in the display includes a polarizing glass filter at the backside and the front side includes at 90 degrees, so the pixel looks dark normally.
- 2) A small twisted nematic liquid crystal is there among the two filters which control electronically. Once it is turned OFF, then it turns the light to pass through 90 degrees, efficiently letting light to supply throughout the two polarizing filters so that pixel seems bright. Once it is activated then it doesn't turn the light because it is blocked through the polarizer & the pixel seems dark. Every pixel can be controlled through a separate transistor by turning ON and OFF several times every second.

THIN FILM TRANSISTOR LIQUID CRYSTAL DISPLAY (TFT LCD)

Liquid Crystal Display (LCD) technology was introduced in the 1970s. LCD based Monitor consists of a thin film of a semiconductor material applied over a glass substrate. Each pixel in a TFT LCD monitor has its own transistor along with the liquid crystal material. LCD based monitors are more compact and consume very low power than CRT based monitor. The LCD based monitor put lesser strain on eye and users can work for long hours. The LCD based monitor emits less harmful rays. However sighting angle of LCD based monitor is narrow, it forces user to seat exactly in front of monitor. Sighting angle of CRT based monitor is very wide. Even two or three people sitting around the monitor can have clear view of the screen.

Monitor is major consumer of electricity in a computer. Most of the monitors switch to power saver mode, when it does not receive any signal from computer for a long. These monitors allow users to set time for auto-switch off. If you are working on laptop or running computer on batteries than set auto-switch time very short, so that power of batteries can be saved and system can work for long.

Flickering in pictures due to electromagnetic field of nearby electrical appliances is very low in LCD based monitor. Brightness of LCD based monitor is very low. One cannot get proper view on LCD based monitor, while working under direct Sun light. The CRT based monitor displays images with higher resolution, it can display more colours than LCD based monitor. However, size of CRT based monitor is large and weighty. It consumes more power and generates more heat.

Video Display Unit

Video Display Unit is used to provide the interface between computer and user. User can operate on the computer system without printer, disk driver but without VDU he would be operate blind means it is impossible to operate on the computer system without video display unit. Video display unit is a combination of two components:

- Video screen
- Video display adapter
- Video screen

is the screen on which we actually see the images in either text or graphics.

• Video display adapter

is a special printed circuit board that plugs into the one of the several expansion slots present on the mother board of a computer system.

How are the images either text or graphics, produced on the screen?

This Task is done by the display adapter because it is not possible for the microprocessor to send signal necessary to produce the image on the screen. So in this case display adapter acts as an agent between the video screen and the microprocessor.

Video display adapter done this work with the help of following components:

- VDU memory on which microprocessor writes the information to be produced on the screen.
- Display Adapter circuitry which transfers the information from video memory to screen.

In this way image is produced on the screen. There are various types of Display adapters which are supported by 8086 microprocessor family:

- Monochrome display adapter (MA)
- Hercules display adapter
- Color Graphics adapter (CGA)
- Enhanced Graphics Adapter (EGA)
- Multicolor Graphics Adapter (MCGA)
- Video Graphics Adapter (VGA)
- Super Video Graphics Adapter (SVGA)
- Extended Graphics Adapter (XGA)

• Monochrome display adaptor (MA)

was the first display adapter. This is a simple adapter which can only operates on text mode. It has no capability to operates on the Graphics mode.

• Hercules Display Adapter

is an advance version of the MA. It has all the features of the MA but in additionally it can also operate in Graphics mode.

• Color Graphics Adapter (CGA)

was in demand for several years but for today's perspectives it has very limited qualities. This adapter can also operate on both text and graphics mode like Hercules Display Adapter. In text mode it operates in 25 rows by 80 columns mode with 16 colors. In Graphics mode two resolutions are available medium resolutions graphics mode (320*200) with forr colors available from a palette of 16 and two colors mode (640*200).

• Multicolor Graphics Adapter (MCGA)

This display adapter is an advance version of the EGA. It also includes all the functionality and display modes of MA, CGA and EGA. It additionally includes two more graphics modes one is 640*480 pixel mode in 2 colors and second is 320*200 pixel mode in 256 color.

• Video Graphics Array (VGA)

The VGA supports all the display modes of MA, CGA, EGA and MCGA. In addition it also supports the graphics mode of resolution 640*480 in 16 colors. SVGA and XGA are also includes all the functions and display modes of all already discussed display adapters. SVGA includes two more display modes of resolution 800*600 and 1024*768 and XGA also includes two new modes: 640*480 pixel mode with 65536 colors and 1024*768 pixel mode with 256 color. Any graphical image is also influenced by the Display screen or monitor. Many monitors cannot produce color or graphics, some produce poor quality of images and some are also there to produce good quality of images. Each display adapter supports certain type of monitors. There are various monitor used with the 8086 microprocessor based computer system which are mentioned below:

- Monochrome monitors
- Composite monochrome monitors
- Composite color monitors
- TV sets
- RGB monitors
- VGA monitors
- VGA color monitors

• Monochrome monitors

use to display high resolution text, but these monitors have not any ability to display graphics. These types of monitors can only work with the Monochrome Adapter (MA).

• Composite monochrome monitors

work with the Color Graphics Adapter (CGA). These monitors provide a fairly good one color image. These types of monitors can display text or graphics but not able to generate colors.

• Composite color monitors

produce not only text and graphics but also colors. The demerit of these types of monitors is that these have some serious limitations like a 80-column display is often unreadable and these have very short number of color combinations and images produce through these type of system are not good in quality and resolutions.