Chapter 6

Output Devices

These are the devices with the help of which we provide output to the user. The output can be in the form of forms, reports, images, audio or video. There are various output devices available.

Monitor

A computer display is a marvelous thing. An unassuming dark gray surface can suddenly transform into an artist's canvas, an engineer's gauges or a writer's page.

Your PC sends digital signals of data to the SVGA (super video graphics array) adapter. For example, image you're working in Microsoft Word. Your PC sends the data that you're typing and the program template as a digital signal. The SVGA adapter then sends the signals through the DAC (digital to analog converter) circuit, which is usually just one specialized chip.

The DAC compares these values and assigns voltage levels for red, green, and blue. This RGB model uses the three primary colors to create the color of a single pixel. The DAC sends the signals to the CRT (cathode ray tube).

CRT

Most monitors today use the traditional CRT, which works on the same scientific principle as a television set. This vacuum tube produces an image when an electron beam strikes the phosphorescent surface inside the monitor.

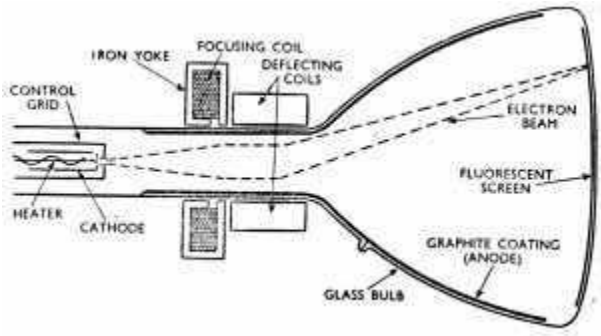

Fig 6.1 Cathode Ray Tube

A CRT contains the following elements:

Electron gun creates a narrow beam of electrons. There is one gun for each primary color (red, green, and blue). The anodes speed up the electrons.
There are two deflecting coils, horizontal and vertical. These coils produce an extremely low frequency electromagnetic field (ELF) that constantly adjusts the direction of the electron beam.
The electron guns generate a beam of electrons in each of those colors to create an overlapping image. The number of pixels displayed, horizontally and vertically determines the monitor's

resolution. A slot mask, also known as a shadow mask, is a metal plate with tons and tons of little holes. These holes keep the electron beams perfectly aligned. More dots closer together create the sharpest image. This measurement is called the dot pitch.

From beam into image

A tiny, bright spot is visible when the electron's beam reaches the phosphor-coated screen. Phosphors glow when struck by electrons. The colors that you see are determined by the intensity of the electrons based on the value determined by the DAC and the assigned RGB.

The complex signals are applied to the deflecting coils, and the intensity of the beam increases. The spot on the screen races from right to left and from top to bottom in a sequence of lines called raster scanning. After the entire screen has been swept by the raster scanning, the beams return to the upper left-hand corner to begin again.

The screen to your monitor is usually redrawn, or refreshed, 60 times a second. The refresh rate is determined by how often the images on the screen are redrawn.

When you look at the monitor, the spot moves the same way that your eyes move when you read. The scanning takes place so quickly that your eyes see a continuous image on the screen.

Printer

There are several major printer technologies available. These technologies can be broken down into two main categories with several types in each:

Impact - These printers have a mechanism that touches the paper in order to create an image. There are two main impact technologies:

Dot matrix printers use a series of small pins to strike a ribbon coated with ink, causing the ink to transfer to the paper at the point of impact.

Character printers are basically computerized typewriters. They have a ball or series of bars with actual characters (letters and numbers) embossed on the surface. The appropriate character is struck against the ink ribbon, transferring the character's image to the paper. Character printers are fast and sharp for basic text, but very limited for other use.

Non-impact

These printers do not touch the paper when creating an image. Inkjet printers are part of this group, which includes:

Inkjet printers use a series of nozzles to spray drops of ink directly on the paper.

Laser printers use dry ink (toner), static electricity, and heat to place and bond the ink onto the

paper.

Fig HP Laser Printer

Solid ink printers contain sticks of wax-like ink that are melted and applied to the paper. The ink then hardens in place.

Dye-sublimation printers have a long roll of transparent film that resembles sheets of red-, blue-, yellow- and gray-colored cellophane stuck together end to end. Embedded in this film are solid dyes corresponding to the four basic colors used in printing: cyan, magenta, yellow and black

(CMYK). The print head uses a heating element that varies in temperature, depending on the amount of a particular color that needs to be applied. The dyes vaporize and permeate the glossy surface of the paper before they return to solid form. The printer does a complete pass over the paper for each of the basic colors, gradually building the image.

Thermal wax printers are something of a hybrid of dye-sublimation and solid ink technologies. They use a ribbon with alternating CMYK color bands. The ribbon passes in front of a print head that has a series of tiny heated pins. The pins cause the wax to melt and adhere to the paper, where it hardens in place.

Thermal autochrome printers have the color in the paper instead of in the printer. There are three layers (cyan, magenta and yellow) in the paper, and each layer is activated by the application of a specific amount of heat. The print head has a heating element that can vary in temperature. The print head passes over the paper three times, providing the appropriate temperature for each color layer as needed.
Out of all of these incredible technologies, inkjet printers are by far the most popular. In fact, the only technology that comes close today is laser printers.
Inkjet printer.

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.

Parts of a typical inkjet printer include:

- **Print head assembly**

Print head - The core of an inkjet printer, the print head contains a series of nozzles that are used to spray drops of ink.
Ink cartridges - Depending on the manufacturer and model of the printer, ink cartridges come in various combinations, such as separate black and color cartridges, color and black in a single cartridge or even a cartridge for each ink color. The cartridges of some inkjet printers include the print head itself.

Print head stepper motor - A stepper motor moves the print head assembly (print head and ink cartridges) back and forth across the paper. Some printers have another stepper motor to **park** the print head assembly when the printer is not in use. Parking means that the print head assembly is restricted from accidentally moving, like a parking brake on a car.
Belt - A belt is used to attach the print head assembly to the stepper motor.
Stabilizer bar - The print head assembly uses a stabilizer bar to ensure that movement is precise and controlled.
Paper feed assembly
Paper tray/feeder - Most inkjet printers have a tray that you load the paper into. Some printers dispense with the standard tray for a **feeder** instead. The feeder typically snaps open at an angle on the back of the printer, allowing you to place paper in it. Feeders generally do not hold as much paper as a traditional paper tray.
Rollers - A set of rollers pull the paper in from the tray or feeder and advance the paper when the print head assembly is ready for another pass.
Paper feed stepper motor - This stepper motor powers the rollers to move the paper in the exact increment needed to ensure a continuous image is printed.
Power supply - While earlier printers often had an external transformer most printers sold today use a standard power supply that is incorporated into the printer itself.
Control circuitry - A small but sophisticated amount of circuitry is built into the printer to control all the mechanical aspects of operation, as well as decode the information sent to the printer from the computer

The primary principle at work in a laser printer is static electricity, the same energy that makes clothes in the dryer stick together or a lightning bolt travel from a thundercloud to the ground. Static electricity is simply an electrical charge built up on an **insulated object**, such as a balloon or your body. Since oppositely charged atoms are attracted to each other, objects with opposite static electricity fields cling together. A laser printer uses this phenomenon as a sort of "temporary glue." The core component of this system is the **photoreceptor**, typically a revolving drum or cylinder. This **drum assembly** is made out of highly **photoconductive** material that is discharged by light photons.

Initially, the drum is given a total **positive charge** by the **charge corona wire**, a wire with an electrical current running through it. (Some printers use a **charged roller** instead of a corona wire, but the principle is the same.) As the drum revolves, the printer shines a tiny laser beam across the surface to discharge certain points. In this way, the laser "draws" the letters and images to be printed as a pattern of electrical charges -- an **electrostatic image**. The system can also work with the charges reversed -- that is, a positive electrostatic image on a negative background.

After the pattern is set, the printer coats the drum with positively charged **toner** -- a fine, black powder. Since it has a positive charge, the toner clings to the negative discharged areas of the drum, but not to the positively charged "background." This is something like writing on a soda can with glue and then rolling it over some flour: The flour only sticks to the glue-coated part of the can, so you end up with a message written in powder.

With the powder pattern affixed, the drum rolls over a sheet of paper, which is moving along a belt below. Before the paper rolls under the drum, it is given a negative charge by the **transfer corona wire** (charged roller). This charge is stronger than the negative charge of the electrostatic image, so the paper can pull the toner powder away. Since it is moving at the same speed as the drum, the paper picks up the image pattern exactly. To keep the paper from clinging to the drum, it is discharged by the **detac corona wire** immediately after picking up the toner.

Finally, the printer passes the paper through the **fuser**, a pair of heated rollers. As the paper passes through these rollers, the loose toner powder melts, fusing with the fibers in the paper. The fuser rolls the paper to the output tray, and you have your finished page. The fuser also heats up the paper itself, of course, which is why pages are always hot when they come out of a laser printer or photocopier.

So what keeps the paper from burning up? Mainly, *speed* -- the paper passes through the rollers so quickly that it doesn't get very hot.

After depositing toner on the paper, the drum surface passes the **discharge lamp**. This bright light exposes the entire photoreceptor surface, erasing the electrical image. The drum surface then passes the charge corona wire, which reapplies the positive charge.

Conceptually, this is all there is to it. Of course, actually bringing everything together is a lot more complex. In the following sections, we'll examine the different components in greater detail to see how they produce text and images so quickly and precisely.

Before a laser printer can do anything else, it needs to receive the page data and figure out how it's going to put everything on the paper. This is the job of the **printer controller**.

The printer controller is the laser printer's main onboard computer. It talks to the host computer through a communications port, such as a parallel port or USB port. At the start of the printing job, the laser printer establishes with the host computer how they will exchange data. The controller may have to start and stop the host computer periodically to process the information it

has received. In an office, a laser printer will probably be connected to several separate host computers, so multiple users can print documents from their machine. The controller handles each one separately, but may be carrying on many "conversations" concurrently. This ability to handle several jobs at once is one of the reasons why laser printers are so popular.

For the printer controller and the host computer to communicate, they need to speak the same **page description language**. In earlier printers, the computer sent a special sort of text file and a simple code giving the printer some basic formatting information. Since these early printers had only a few fonts, this was a very straightforward process.

These days, you might have hundreds of different fonts to choose from, and you wouldn't think twice about printing a complex graphic. To handle all of this diverse information, the printer needs to speak a more advanced language.

The primary printer languages these days are Hewlett Packard's **Printer Command Language** (PCL) and Adobe's **Postscript**. Both of these languages describe the page in **vector** form -- that is, as mathematical values of geometric shapes, rather than as a series of dots (a **bitmap** image). The printer itself takes the vector images and converts them into a bitmap page. With this system, the printer can receive elaborate, complex pages, featuring any sort of font or image. Also, since the printer creates the bitmap image itself, it can use its maximum printer resolution.

Some printers use a **graphical device interface** (GDI) format instead of a standard PCL. In this system, the host computer creates the dot array itself, so the controller doesn't have to process anything -- it just sends the dot instructions on to the laser.

But in most laser printers, the controller must organize all of the data it receives from the host computer. This includes all of the commands that tell the printer what to do -- what paper to use, how to format the page, how to handle the font, etc. For the controller to work with this data, it has to get it in the right order.

Once the data is structured, the controller begins putting the page together. It sets the text margins, arranges the words and places any graphics. When the page is arranged, the **raster image processor** (RIP) takes the page data, either as a whole or piece by piece, and breaks it down into an array of tiny dots. As we'll see in the next section, the printer needs the page in this form so the laser can write it out on the photoreceptor drum.

In most laser printers, the controller saves all print-job data in its own memory. This lets the controller put different printing jobs into a **queue** so it can work through them one at a time. It also saves time when printing multiple copies of a document, since the host computer only has to send the data once.

Since it actually draws the page, the printer's laser system -- or **laser scanning assembly** -- must be incredibly precise. The traditional laser scanning assembly includes:

A **laser**

A **movable mirror**

A **lens**

The laser receives the page data -- the tiny dots that make up the text and images -- one horizontal line at a time. As the beam moves across the drum, the laser emits a pulse of light for every dot to be printed, and no pulse for every dot of empty space.

The laser doesn't actually move the beam itself. It bounces the beam off a movable **mirror** instead. As the mirror moves, it shines the beam through a series of **lenses**. This system compensates for the image distortion caused by the varying distance between the mirror and points along the drum.

The laser assembly moves in only one plane, horizontally. After each horizontal scan, the printer moves the photoreceptor drum up a notch so the laser assembly can draw the next line. A small **print-engine computer** synchronizes all of this perfectly, even at dizzying speeds.

Some laser printers use a strip of **light emitting diodes** (LEDs) to write the page image, instead of a single laser. Each dot position has its own dedicated light, which means the printer has one

set print resolution. These systems cost less to manufacture than true laser assemblies, but they produce inferior results. Typically, you'll only find them in less expensive printers

Multiple Choice Questions

41. Which is not a Input device.

a) Light Pen b) KeyBoard

c) Scanner d) Compact Disk

42. The Following is not a technology of switch keyboards .

a) Foam Element b) Membrane

c) Rubber Dome d) Electronic Foam

43. Following is not a type of technology available in Mouse

a) Mechanical b) Electrical

c) Optical d) Optomechanical

44. Webcam is useful for.

a) Video Chatting b) Remote Video

b) Searching the Internet c) Transferring the video

45. With Light Pen we can draw Directly on _____.

a) Any Surface b) Paper

c) table d) Screen

46. _____is an input device that enables conversion of printed material into a machine-readable form.

a) Light pen b) Scanner

c) WebCam d) Mouse

47. For A webcam we require

a) A camera b) A webserver

c) Software to install d) all the three

48. Pattern Recognition algorithms are used to read _____.

a) Typed material b) Printed Material

c) Hand written Material d) None of these

49. Microphone is a _____Input device.

a) Voice b) text

c) Pressure d) video

50. Capacitive technology Keyboards resist _____.

a) Moisture b) Pressure

b) dirt d) water

51.

a) Latency b) Average time

c) Seek time d) Access time

52. The storage capacity requirements of an individual are_____.

a) Decreasing b) constant

c) Increasing d) zero

53. Which is not a part of FDD.

a) stepper motor b) lens system

c) drive motor d) Mechanical Frame

54. Disk Transfer rate is_____.

a) time to transfer the disk b) time to erase the data from the disk

d) time to replace the disk d) time to transfer data to & from the disk

55. when certain data is required & data is found in the cache.

a) Cache Hit b) RAM Hit

c) Data Hit d) Memory Hit

56. Thumb drive is attached to _____.

a) Serial Port b) USB Port

c) Parallel Port d) Any of the three

57. DVD can store

a) A full Video Movie
b) Rich Multimedia
c) Sophisticated Software Packages
d) All the three

58.

a) IBM
b) HP
c) Microsoft
d) ENRON

59. Joy Stick is not used in

a) Playing games
b) controlling Wheel Chairs
c) Writing Software Programs
d) controlling robots

60.

a) Decreasing
b) increasing
c) Constant
d) none of these

Review Questions

11. Explain the following terms
    a) Speakers
    b) Monitors
    c) Inkjet Printers

12. Compare the various printers & their utilities at various places.
13. Explain the working of the laser printer.
14. What is the difference between Impact & Non Impact printers.
15. Explain the working of Dot matrix Printers.

Discussion questions

7. With the coming of wireless computing how the output devices are changing.

8. We are talking of paperless offices but the use of printers is increasing day by day. Discuss.

9. Explore the health issues related to eyes due to Monitors.

Answers to Multiple Choice Questions:

41. c
42. a
43. d
44. a
45. d
46. a
47. c
48. b
49. d
50. d
51. b
52. c
53. b
54. d
55. c
56. d
57. d
58. d
59. b
60. a

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