

4.5 INPUT AND OUTPUT DEVICES

The common input and output devices are discussed here:

Input Devices Keyboard

- ▮ A keyboard has its own processor and circuitry that carries information to and from that processor. A large part of this circuitry makes up the **key matrix which is arranged in rows and columns.**
- ▮ The key matrix is a grid of circuits underneath the keys.
- ▮ In all keyboards each circuit is broken at a point below each key. When a key is pressed, it presses a switch, completing the circuit and allowing a tiny amount of current to flow through.
- ▮ The mechanical action of the switch causes some vibration, called **bounce**, which the processor filters out.
- ▮ If the key is pressed and held continuously, the processor recognizes it as the equivalent of pressing a key repeatedly.
- ▮ Another type of keyboard has three layers: top plasticized layer with key positions marked on the top surface and conducting traces on another side; middle layer made of rubber with hole for key positions; bottom metallic layer with raised bumps for key positions.
- ▮ When a key is pressed the trace underneath the top layer comes in contact with the bump in the last layer, thus completing an electrical circuit. The current flow is sensed by the microcontroller.

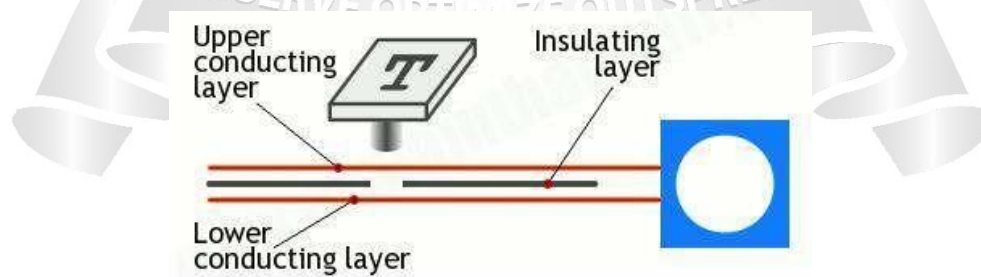


Fig 1: Layers in keyboard

Source: Miles J. Murdocca and Vincent P. Heuring, —Computer Architecture and Organization: An Integrated approach

Mouse

- ▮ A computer mouse is a hand-held pointing device that detects two-dimensional motion relative to a surface.
- ▮ This motion is typically translated into the motion of a pointer on a display, which allows a smooth control of the graphical user interface.
- ▮ There are two main kinds of mice: rolling rubber ball mouse or optical mouse.
- ▮ As the mouse is moved, the ball rolls under its own weight and pushes against two plastic rollers linked to thin wheels.
- ▮ One of the wheels detects movements in an up-and-down direction (y-axis) and the other detects side-to-side movements (x-axis).
If the mouse is moved straight up, only the y-axis wheel turns. If the mouse is moved to the right, only the x-axis wheel turns.
- ▮ The optical mouse shines a bright light down onto the desk from an LED mounted on the bottom of the mouse.
- ▮ The light bounces straight back up off the desk into a photocell also mounted under the mouse, a short distance from the LED.
- ▮ The photocell has a lens in front of it that magnifies the reflected light, so the mouse can respond more precisely to your hand movements.
- ▮ As the mouse is pushed, the pattern of reflected light changes, and the chip inside the mouse uses this to figure out the motion.

Trackball, Joystick and Touch pad

- ▮ A trackball can also be used as an alternative to a mouse. This device also has buttons similar to those on a mouse.
- ▮ It holds a large moving ball on the top. The body of the trackball is not moved. The ball is rolled with fingers. The position of the cursor on the screen is controlled by rotating the ball.
- ▮ The main benefit of the trackball over a mouse is that it takes less space to move. The trackball is often included in laptop computers. The standard desktop computer also uses a trackball operated as a separate input device.

- ▮ A touchpad is a small, plane surface over which the user moves his finger. The user controls the movement of the cursor on the screen by moving his fingers on the touchpad. It is also known as a track pad.
- ▮ A touchpad also has one or more buttons near it. These button work like mouse buttons. Touchpads are commonly used with notebook computers.
- ▮ A joystick consists of a base and a stick. The stick can be moved in several directions to shift an object anywhere on the computer screen.
- ▮ A joystick can perform a similar function to a mouse or trackball. It is often considered less comfortable and efficient. The most common use of a joystick is for playing computer games.

Scanners

- ▮ Scanners operate by shining light at the object or document being digitized and directing the reflected light onto a photosensitive element.
- ▮ In most scanners, the sensing medium is an electronic, light-sensing integrated circuit known as a charged coupled device (CCD).
- ▮ Light-sensitive photo sites arrayed along the CCD convert levels of brightness into electronic signals that are then processed into a digital image.
- ▮ A scanner consists of a flat transparent glass bed under which the CCD sensors, lamp, lenses, filters and also mirrors are fixed.
- ▮ The document has to be placed on the glass bed. There will also be a cover to close the scanner.
- ▮ The lamp brightens up the text to be scanned. Most scanners use a cold cathode fluorescent lamp (CCFL).
- ▮ A stepper motor under the scanner moves the scanner head from one end to the other. The movement will be slow and is controlled by a belt.
- ▮ The scanner head consists of the mirrors, lens, CCD sensors and also the filter. The scan head moves parallel to the glass bed and that too in a constant path.
- ▮ As the scan head moves under the glass bed, the light from the lamp hits the document and is reflected back with the help of mirrors angled to one another.

- ▮ According to the design of the device there may be either 2-way mirrors or 3-way mirrors.
- ▮ The mirrors will be angled in such a way that the reflected image will be hitting a smaller surface.
- ▮ In the end, the image will reach a lens which passes it through a filter and causes the image to be focused on CCD sensors.
- ▮ The CCD sensors convert the light to electrical signals according to its intensity. The electrical signals will be converted into image format inside a computer.

Output Devices Video Displays

- ▮ The CRT monitors were fundamental output display device.
- ▮ The CRT or cathode ray tube, is the picture tube of a monitor.
- ▮ The back of the tube has a negatively charged cathode.
- ▮ The electron gun shoots electrons down the tube and onto a charged screen.
- ▮ The screen is coated with a pattern of dots using phosphor that glow when struck by the electron stream.
- ▮ The image on the monitor screen is usually made up from at least tens of thousands of such tiny dots glowing on command from the computer.
- ▮ The closer together the pixels are, the sharper the image on screen.
- ▮ The distance between pixels on a computer monitor screen is called its dot pitch and is measured in millimeters. Most monitors have a dot pitch of 0.28 mm or less.
- ▮ There are two electromagnets around the collar of the tube which deflect the electron beam.
- ▮ The beam scans across the top of the monitor from left to right, is then blanked and moved back to the left-hand side slightly below the previous trace (on the next scan line), scans across the second line and so on until the bottom right of the screen is reached.
- ▮ The beam is again blanked, and moved back to the top left to start again.
- ▮ This process draws a complete picture, typically 50 to 100 times a second.

- ▮ The number of times in one second that the electron gun redraws the entire image is called the refresh rate and is measured in hertz (cycles per second).
- ▮ It is common, particularly in lower priced equipment, for all the odd-numbered lines of an image to be traced, and then all the even-numbered lines; the circuitry of such an interlaced display need to be have only half the speed of a non-interlaced display.
- ▮ An interlaced display, particularly at a relatively low refresh rate, can appear to some observers to flicker, and may cause eye strain and nausea.
- ▮ The intensity or strength of the electron beam is controlled by setting the voltage levels.
- ▮ The number of electrons that hits the screen determines the light emitted by the screen.
When the voltage is varied in the electron gun, the brightness of the display also varies.
- ▮ The focusing hardware focuses the beam at all positions on the screen.
- ▮ The deflection of electron beam is controlled by electric or magnetic fields.
- ▮ Two pairs of coils mounted on the CRT to produce the necessary deflection.
- ▮ The coils are placed in such a way that, the magnetic field produced by them results in traverse deflection force that is perpendicular to the magnetic field and electron beam.

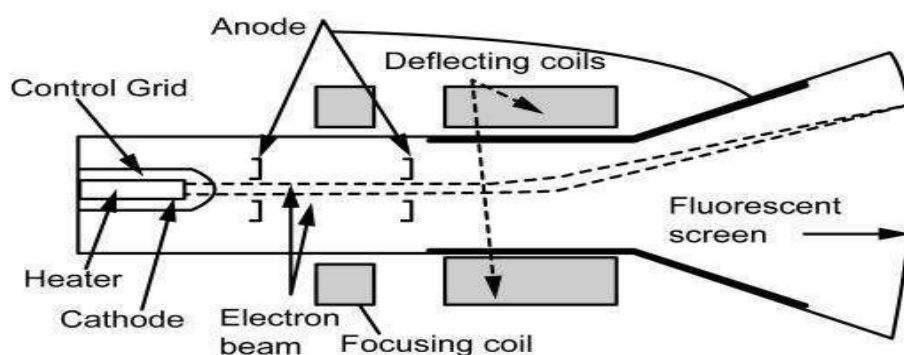


Fig 2: CRT Monitor

Source: Miles J. Murdocca and Vincent P. Heuring, —Computer Architecture and Organization: An Integrated approach

- ▮ An LED screen is an LCD screen, but instead of having a normal CCFL backlight, it uses light-emitting diodes (LEDs) as a source of light behind the screen.
- ▮ An LED is more energy efficient and a lot smaller than a CCFL, enabling a thinner television screen.

Printers

- ▮ A printer is an electromechanical device which converts the text and graphical documents from electronic form to the physical form.
- ▮ They are the external peripheral devices which are connected with the computers or laptops through a cable or wirelessly to receive input data and print them on the papers.
- ▮ Quality of printers is identified by its features like color quality, speed of printing, resolution etc. Modern printers come with multipurpose functions i.e. they are combination of printer, scanner, photocopier, fax, etc.
- ▮ Broadly printers are categorized as impact and non impact printers.

Daisy Wheel Printers

- ▮ Daisy wheel printers print only characters and symbols and cannot print graphics. They are generally slow with a printing speed of about 10 to 75 characters per second.
- ▮ A circular printing element is the heart of these printers that contains all text, numeric characters and symbols mould on each petal on the circumference of the circle.
- ▮ The printing element rotates rapidly with the help of a servo motor and pauses to allow the printing hammer to strike the character against the paper.

Dot Matrix Printers

- ▮ It is a popular computer printer that prints text and graphics on the paper by using tiny dots to form the desired shapes.
- ▮ It uses an array of metal pins known as print head to strike an inked printer ribbon and produce dots on the paper.
- ▮ These combinations of dots form the desired shape on the paper.
- ▮ The key component in the dot matrix printer is the †print head† which is about one inch long and contains a number of tiny pins aligned in a column varying from 9 to 24.
- ▮ The print head is driven by several hammers which force each pin to make contact with the paper at the certain time. These hammers are pulled by small electromagnet which is energized at a specific time depending on the character to be printed.
- ▮ The timings of the signals sent to the solenoids are programmed in the printer for each character.

Inkjet printers

- ▮ Inkjet printers are most popular printers for home and small scale offices as they have a reasonable cost and a good quality of printing as well.
- ▮ An inkjet printer is made of the following parts:
 - i) Print head – It is the heart of the printer which holds a series a nozzles which sprays the ink drops over the paper.

Ink cartridge – It is the part that contains the ink for printing. Generally monochrome (black & white) printers contain a black colored ink cartridges and a color printer contains two cartridges – one with black ink and other with primary colors (cyan, magenta and yellow).
 - ii) Stepper motor – It is housed in the printer to move the printer head and ink cartridges back and forth across the paper.
 - iii) Stabilizer bar – A stabilizer bar is used in printer to ensure the movement of print head is précised and controlled over the paper.

- iv) Belt – A belt is used to attach the print head with the stepper motor.
- v) Paper Tray – It is the place where papers are placed to be printed.
- vi) Rollers – Printers have a set of rollers that helps to pull paper from the tray for printing purpose.
- vii) Paper tray stepper motor- another stepper motor is used to rotate the rollers in order to pull the paper in the printer.
- viii) Control Circuitry – The control circuit takes the input from the computer and by decoding the input controls all mechanical operation of the printer.

Laser Printers

- ▮ Laser printers are the most popular printers that are mainly used for large scale qualitative printing.
- ▮ They are among the most popularly used fastest printers available in the market.
- ▮ A laser printer uses a slight different approach for printing. It does not use ink like inkjet printers, instead it uses a very fine powder known as Toner.
- ▮ The control circuitry is the part of the printer that talks with the computer and receives the printing data.
- ▮ A Raster Image Processor (RIP) converts the text and images in to a virtual matrix of dots.
- ▮ The photo conducting drum which is the key component of the laser printer has a special coating which receives the positive and negative charge from a charging roller.
- ▮ A rapidly switching laser beam scans the charged drum line by line. When the beam flashes on, it reverses the charge of tiny spots on the drum, respecting to the dots that are to be printed black.
- ▮ As soon the laser scans a line, a stepper motor moves the drum in order to scan the next line by the laser.
- ▮ A developer roller plays the vital role to paste the tonner on the paper. It is coated with charged tonner particles.
- ▮ As the drum touches the developer roller, the charged tonner particles cling to the

discharged areas of the drum, reproducing your images and text reversely.

- ▮ Meanwhile a paper is drawn from the paper tray with help of a belt. As the paper passes through a charging wire it applies a charge on it opposite to the toner's charge.
- ▮ When the paper meets the drum, due to the opposite charge between the paper and toner particles, the toner particles are transferred to the paper.
- ▮ A cleaning blade then cleans the drum and the whole process runs smoothly continuously.

Finally paper passes through the fuser which is a heat and presser roller, melts the toner and fixes on the paper perfectly.

