Keyboard

Keyboard is common input device.it allow a user to communicate with the PC through keystrokes that represent character data and commands. A keyboard is connected to a computer system using a cable or a wireless connection. Keyboard have following group of keys

- Alphabetic keys
- Cursor control keys
- Function keys
- Number pad keys
- Special purpose keys
- Window keys

Keyboard Operation

Keyboard have two main components a chip and key matrix. Keyboard perform operation with the help of these two components

Keyboard Controller

A **keyboard controller** is a device that interfaces a keyboard to a computer. Its main function is to inform the computer when a key is pressed or released. When data from the keyboard arrives, the controller raises an interrupt (a *keyboard interrupt*) to allow the CPU to handle the input. Keyboard controller in the form of IC chip. it consist of RAM, ROM, Processor and other input/output registers. **keyboard controller** convert key presses into key codes (usually scancodes) that the computer's electronics can understand.

KeyMatrix

The keyboard has its own processor and circuitry, a majority of which forms an important component called key matrix. The key matrix is a collection of circuits under the keyboard, which is broken at a specific point under every key, which results in making the circuit incomplete. When you press any particular key, it completes this circuit, thus, enabling the processor to determine the location of the key that was pressed.

Working of Keyboard

The key matrix is a grid of circuits underneath the keys. In all keyboards (except for capacitive models), each circuit is broken at a point below each key. When you press a key, 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 you press and hold a key, the processor recognizes it as the equivalent of pressing a key repeatedly.

When the processor finds a circuit that is closed, it compares the location of that circuit on the key matrix to the character map in its read-only memory (ROM). A character map is basically a comparison chart or lookup table. It tells the processor the position of each key in the matrix and what each keystroke or combination of keystrokes represents. For example, the character map lets the processor know that pressing the a key by itself corresponds to a small letter "a," but the Shift and keys pressed together correspond to a capital "A."

- When a key is pressed keyboard send electronic signal/scan code to the computer
- Keyboard controller interpret the scan code and find which key is pressed. And store code in buffer, so that bios can read it when processor is ready
- The controller sends an interrupt to the processor
- Main processor receives interrupt and issue interrupt service routine for keyboard
- Interrupt service routine in BIOS read code from the buffer and make buffer free
- Bios convert scan code into ASCII code using character map
- ASCII code is passed to the application

Keyboard Cable

The cable that connects the keyboard to the PC is a four wire cable that provides four signs carried between the PC and keyboard. Cable is usually 4-6 feet in length. Following are type of signals carried by cable

- Data

- Clock

- Ground

- Power

Types of Keyboard

1.Standard Keyboard

A standard keyboard is also called a "QWERTY" keyboard. It is the standard layout of keys that are positioned for ideal speed when typing. A standard keyboard does not have double keys like CTRL, ALT, DEL, PGDN, PGUP, SHIFT etc. Again standard keyboard has function key F1 to F10. A standard keyboard has 96 characters.

Standard keyboard is different from Enhanced/Extended keyboard which has 102 characters, has double of the above mentioned keys and has function keys from F1 to F12.

2.Ergonomic Computer Keyboards

Ergonomic Keyboards are broad and different shaped with spaces between two set of keys that makes you work easier. Ergonomic keyboard keeps the hand in a neutral position by preventing you to restrain your hands or wrists while you type. You only need to use light touch to type with ergonomic keyboards which prevents you from forcefully pressing the keyboards. The numeric pad on the ergonomic keyboards is located on the left so the mouse can be much closer to the right. Ergonomic keyboard maintains good vertical hand position and alternative pointing devices such as mouse and touchpads to minimize the need of extending the user's reach to operate the mouse

3.Gaming Keyboards

Gaming keyboards are similar to normal keyboards except they generally contain extra features such as illuminated keys, multimedia keys, an additional LCD screen, palm rest and other features.

Illuminated keyboards are useful for playing games, during the night, when it's too dark to see the keyboard normally. The multimedia keys are also useful for adjusting the volume, for changing the music tracks and for doing other things, while continually playing your game.consists of programmable keys, macro functions or digital displays that can be used for playing games. It can be connected through wire by USB and also wireless. These

keyboards have gaming features like key lighting, volume control, brightness etc.it is available in both wired and wireless categories.

4.Multimedia Keyboard

Multimedia Keyboards are similar to standard keyboard that has several additional keys and buttons for multimedia purpose like volume, brightness and video controls. Multimedia keyboards streamline your music-listening experience on a computer by providing keys that match a traditional CD player's controls. While designed with music in mind, the added keyboard control may prove beneficial for other reasons.

5.Internet Keyboard

A computer keyboard that contains buttons for common Internet functions such as launching the Web browser and email applications and controlling sound volume. Internet Keyboards are specially designed for the Internet users that include special keys like e-mail launch, browser launch, home, back and forward key.

6.Ergonomic keyboard

An **ergonomic keyboard** is a computer **keyboard** designed with **ergonomic** considerations to minimize muscle strain and a host of related problems. Typically, such **keyboards** for two-handed typists are constructed in a V shape, to allow right and left hands to type at a slight angle more natural to the human form. Benefits of ergonomic keyboard

1. Ergonomic keyboard maintains good vertical hand position and alternative pointing devices such as mouse and touchpads to minimize the need of extending the user's reach to operate the mouse.
2. Ergonomic keyboard keeps the hand in a neutral position by preventing you to restrain your hands or wrists while you type.
3. You only need to use light touch to type with ergonomic keyboards which prevents you from forcefully pressing the keyboards.
4. Ergonomic keyboards have contoured layouts which puts the keys into two depressions at shoulder width so that both arms are perpendicular to the body.
5. Ergonomic keyboards have vertical key layout which allows the user to type with his hands vertically and in thumbs up position to avoid wrist rotation.
6. The numeric pad on the ergonomic keyboards is located on the left so the mouse can be much closer to the right.

7. You position your hands naturally when you use ergonomic keyboard.

Wireless Keyboard

A **wireless keyboard** is a computer **keyboard** that allows the user to communicate with computers, tablets, or laptops with the help of radio frequency (RF), infrared (IR) or Bluetooth technology.

keyboards based on infrared technology use light waves to transmit signals to other infrared-enabled devices.

A wireless keyboard can be connected using RF technology with the help of two parts, a transmitter and a receiver. The radio transmitter is inside the wireless keyboard. The radio receiver plugs into a keyboard port or USB port. Once the receiver and transmitter are plugged in, the computer recognizes the keyboard and mouse as if they were connected via a cable.

 A *Bluetooth keyboard* is a wireless keyboard that connects and communicates with its parent device via the Bluetooth protocol. These devices are widely used with such portable devices as phones and tablets, though they are also used with laptops and ultra books. Bluetooth keyboards became popular in 2011, coincident with the popularity of portable devices.

Most Bluetooth keyboards have standard qwerty layouts, though some mini Bluetooth keyboards may have a different layout. Bluetooth keyboards are compatible with all the leading operating systems

Types of wireless keyboards

- Standard size wireless keyboard: These keyboards are standard size wireless keyboard.

- Foldable – Flexible material allow to fold keyboard

- Portable keyboard with touchpad: Keyboard comes with integrated touch pad.

- Portable with Stand - comes with tablet/smartphone stand

- Roll-up wireless keyboard: wireless keyboard that can be rolled up when not in use.

- Mini Wireless Keyboard: Palm sized keyboard with an integrated touch pad; uses thumb typing

- slim keyboard

- With touch pad - combined keyboard and touchpad

Virtual Keyboard

A virtual keyboard is a computer keyboard that a user operates by typing on or within a wireless- or optical-detectable surface or area rather than by depressing physical keys. Such a system can enable the user of a small handheld device, such as a cellular telephone or a PDA (personal digital assistant) to have full keyboard capability.

The term *virtual keyboard* is sometimes used to mean a soft keyboard , which appears on a display screen as an image map . In some cases, a software-based keyboard can be customized. Depending on the host system and specifc software, the user (who may be someone unable to use a regular keyboard) can use a touch screen or a mouse to select the keys.
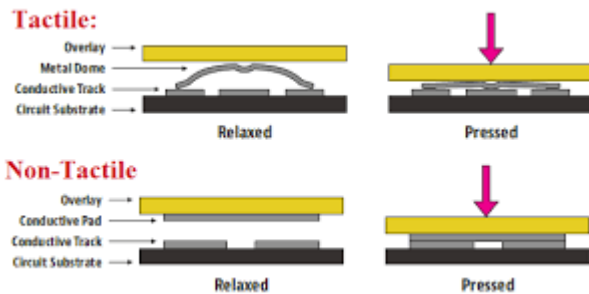
Key switches

Key switches generally of two types-Contact Switches and capacitive switches

Contact Key switches-contact key switches require two parts of the switch to make contact in order to complete a circuit. There are three types of contact key switches used in PC keyboards.

Membrane Switch

Membrane keyboards use a continuous membrane that stretches from one end to another. A pattern printed in the membrane completes the circuit when you press a key. Some membrane keyboards use a flat surface printed with representations of each key rather than

keycaps. Membrane keyboards don't have good tactile response, and without additional mechanical components they don't make the clicking sound that some people like to hear when they're typing. However, they're generally inexpensive to make.


Mechanical Contact Key switch-It is a simple switch in which two metal contact are brought into contact or a metal plunger is pressed against contacts on a circuit board when the switch is pressed. The circuit is completed.This type of switch is not common on current keyboard.

1. **Keycap**. The plastic top cap with the letter printing.
2. **Switch housing**. The case that holds all the components together.
3. **Spring**. The spring wraps around the base of the slider and pushes the switch back into its resting position after release.
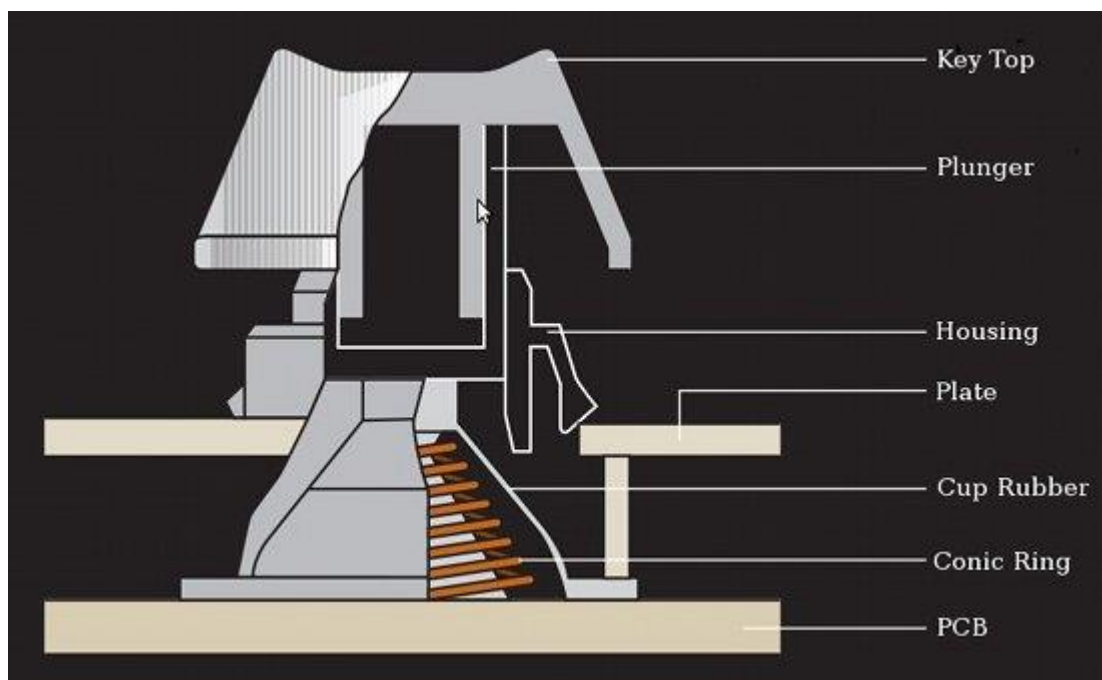
Foam and Foil Contact key switch-Metal contact and foam element keyboards are increasingly less common. Metal contact switches simply have a spring-loaded key with a strip of metal on the bottom of the plunger. When the key is pressed, the metal strip connects the two parts of the circuit. The foam element switch is basically the same design but with a small piece of spongy foam between the bottom of the plunger and the metal strip, providing a better tactile response. It is a made up of a plunger that is connected to a foam pad that has a piece of foil on its underside. A circuit board with a pair of copper contact for each key switch sits under the keyswitches.when a key is pressed the foam pad is pressed down and the foil contacts the contact, completing circuit. This type of keyboard have soft key touch.
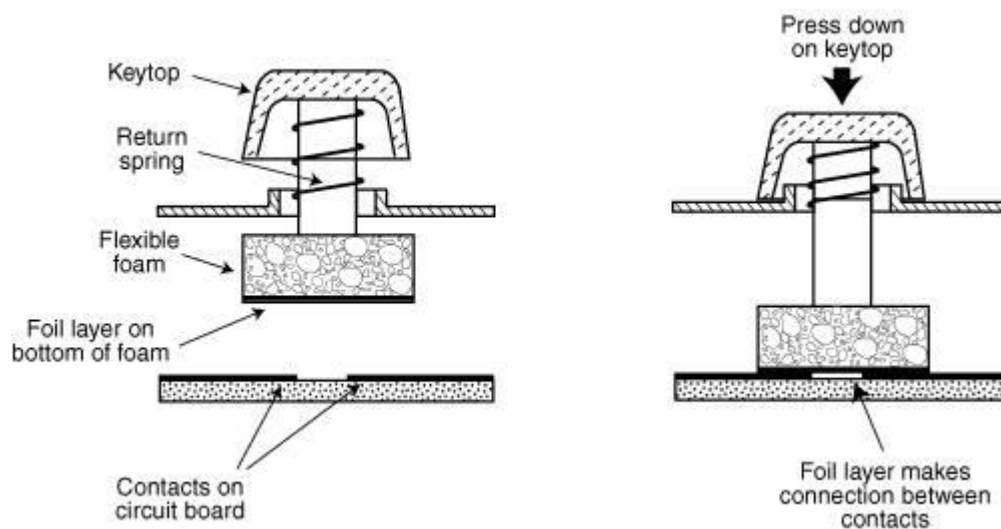

Rubber Dome Keyswitches-Rubber dome switches are very common. They use small, flexible rubber domes, each with a hard carbon center. When you press a key, a plunger on the bottom of the key pushes down against the dome, and the carbon center presses against a hard, flat surface beneath the key matrix. As long as the key is held, the carbon center completes the circuit. When the key is released, the rubber dome springs back to its original shape, forcing the key back up to its at-rest position. Rubber dome switch keyboards are inexpensive also called carbon contact keyswitch.commnly used in these days.

sitesdoneright.com

Capacitive Key switches-a capacitor is an electronic device that stores an electrical charge between two plates. The charge in capacitor is measured as its capacitance. When the plates of capacitor move closer or further away, the capacitance changes. This is the principal of capacitive switch.

In Capacitive switch plunger has a metal plate attached to its bottom. When the plunger is pressed down the space between the plate and other plate located below plunger is reduced. Keyboard circuit detects the change in the key switch's capacitance and a keystroke isdetected. This type of keyboard is very expensive.Capacitive keyboards are more durable than contact keyboards and are resistant to oxidization, which can weaken a keyboard's mechanics.
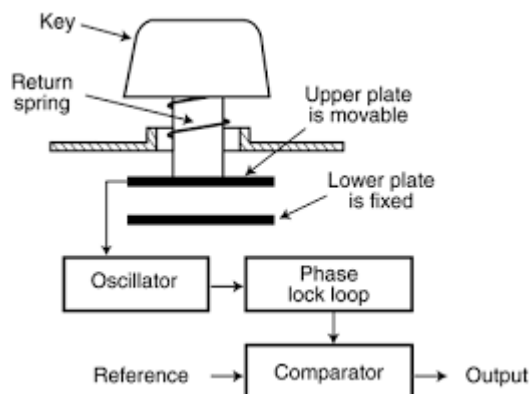
Keyboard /Mouse Interface (Connectors)-The method used to connect a keyboard to the computer is known as keyboard interfacing. The keyboard interface receives the scan code in a serial code format from keyboard.

5 pin DIN and PS/2 connector

The shape of these connectors is different but they carry almost same signals from keyboard to computer system. Purpose of each pin is described below

- Pin 1-this pin's wire is used to send a keyboard clock signal to synchronize the keyboard's logic with the computer system
- Pin 2- this pin's wire is used to carry keyboard data to the computer in serial format
- Pin 3-Unused
- Pin 4- it is used as a ground
- Pin 5- it is used to carry +5v DC current to the keyboard

AT keyboard connector (DIN5)

Connector Pin #	Purpose
Pin 1	KBDCLK (clock)
Pin 2	KBDAT (data)
Pin 3	KBRST (reset, not used)
Pin 4	GND
Pin 5	VCC (+5V)

PS/2 keyboard connector (MINI-DIN6)

Connector Pin #	Purpose
Pin 1	KBDAT (data)
Pin 2	not used
Pin 3	GND
Pin 4	VCC (+5V)
Pin 5	KBDCLK (clock)
Pin 6	not used

USB Connector

- use Universal serial bus to connect to CPU
- Plug and Play interface
- No need to connect to mouse port
- Are hot swappable means keyboards can be plugged in or removed at any time while the computer is running

IrDa(Infrared connector)/Radio frequency keyboard

- Infrared keyboards are to be kept in the lone of sight of the receiver
- Infrared transmitter and receiver is required to establish link between keyboard and Computer system
- No obstacle is required between transmitter and receiver

- Each time the keyboard sends a wireless key make code to the host computer indicating that key is depressed, the host waits a key break code indicating that kay has been released.
- Radio frequency keyboard uses batteries or have a USB cable to charge the keyboard
- Radio frequency keyboard provides a greater range than the infrared keyboards

Mouse

The mouse is a small device used to point to a particular place on the screen.it control the movement of cursor. Generally it have three buttons left button, right button and scroll button in between two.A mouse is an input device that can be used to control the computer. It is a small object that can roll along a hard, flat surface. Its name is derived from its shape, which looks a bit like a mouse, its connecting wire that one can imagine to be the mouse's tail, and the fact that one must make it scurry along a surface. A pointer or a cursor indicates the current spot of activity on the screen. The mouse pointer is an indicator on the screen that moves when the mouse moves. A common way in which we communicate with the computer is by moving the mouse pointer to the required spot and clicking to perform an action. The user clicks the mouse to initiate some action. Depending on which button is pressed, we call it a right click or a left click.

Types of Mouse

- **Mechanical**
  It has a rubber or metal ball on its underside and can roll in every direction.
  There are mechanical sensors within the mouse. Sensor detect the direction in which the ball is moving and moves the pointer on the screen in the same direction.
  Mouse pad is required
- **Optical**
  Uses laser to detect mouse movement.
  Mouse pad is not required.
  Respond more quickly.
  It does not have any mechanical part
- **Opto-mechanical**
  Uses optical sensors to detect motion of the ball.
  Combination of optical and mechanical technologies

Mouse pad is required

- **Laser Mouse**

  Uses two components light emitter and light detector

  Uses laser as a light emitter

 Can find 1000-5700 dots per inch

Types of Mouse

Ball Style Mouse

Traditional mice have a rubber ball inside them. Open one up and you can see the heavy ball clearly and the spring that keeps it in position.

Here's the inside of an old-style Logitech ball mouse:

1. Switch detects clicks of left mouse button.
2. Switch for middle button.
3. Switch for right button.
4. Old-style connection to PS/2 socket on computer.
5. Chip turns back-and-forth (analog) mouse movements into numeric (digital) signals computer can understand.
6. X-axis wheel turns when you move mouse left and right.
7. Y-axis wheel turns when you move mouse up and down.
8. Heavy rubber wheel.
9. Spring presses rubber ball firmly against X- and Y-axis wheels so they register movements proper
10. Electrolytic capacitor
11. Resistors.
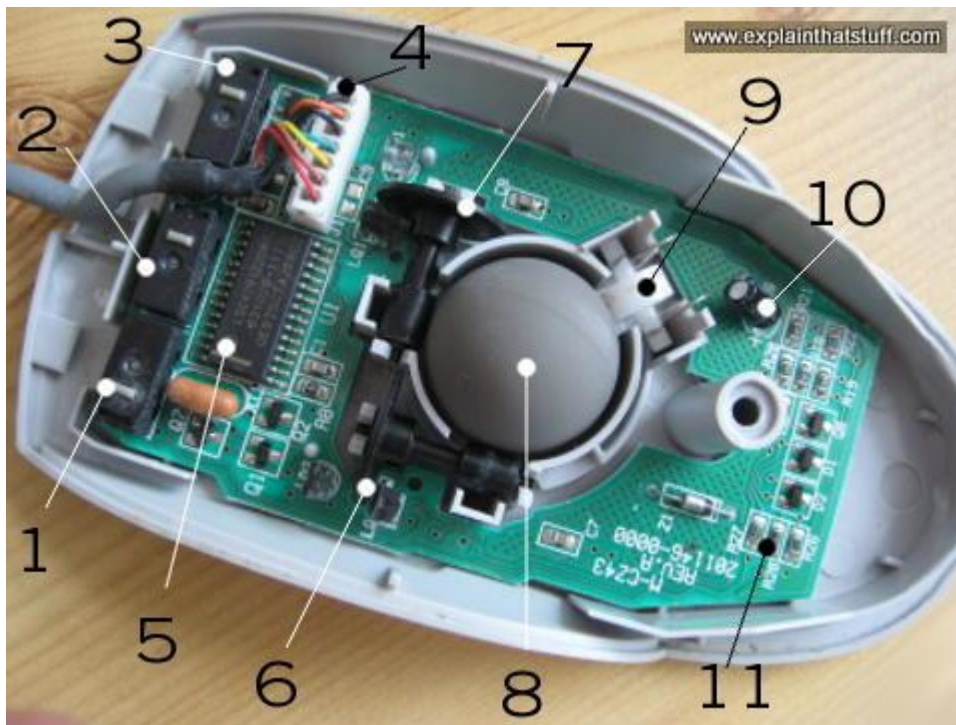
Optical mouse-An optical mouse is much more hi-tech than a ball mouse. Where a ball mouse has quite a few moving parts, an optical mouse is almost entirely electronic (it has almost no moving parts).

1. An LED at the back generates red light and shines it horizontally, from the back of the mouse toward the front (from the left to the right of this photo).
2. A plastic light guide channels the light from the LED at an angle, down onto the desk.
3. A light-detector chip measures light reflected back up from the desk, converting the analog movements of your hand into digital signals that can be sent to your computer.
4. The scroll wheel at the front of the mouse is mounted on a switch mechanism that detects both how much it's rotated and whether you've pressed it (it functions like the central button of a conventional mouse). Rotations of the scroll wheel can be detected in a variety of different ways. Some mice use potentiometers Others use various kinds of rotary switches or optical (rotary) encoders to convert analog wheel movements to digital signals.
5. A micro switch detects when you press the right mouse button. There's an identical switch on the other side to detect the left mouse button.

6. The USB cable connection carries digital information from the mouse to your computer.
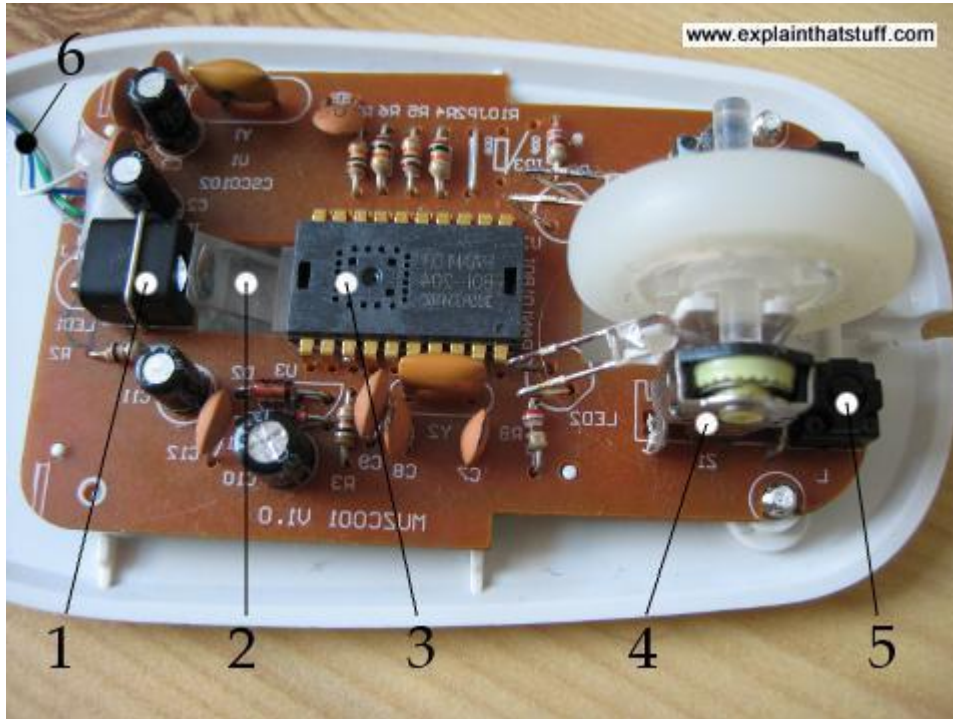
Opto-Mecanical Mouse

- Basic construction of Opto mechanical mouse is same as that of the mechanical mouse.

- Only different is in the sensing circuit i.e. a combination of LED and photo detector is used to sense the distance travelled by the mouse.

- In this mouse, there are two rollers as similar to the mechanical mouse. Each roller is connected to a wheel. There is small opening on the rim of each wheel.

- As the wheel rotates a pair of LED and photo detectors detect the number of opening passed between them.

- Each opening on the wheel allows the light from the LED to fall on the photo detector and generates an electrical signal.

- Then these signals are passed to the PC, in turn, it passes them to mouse driver software which then converts them into distance, direction and speed required for the movement of the screen cursor.
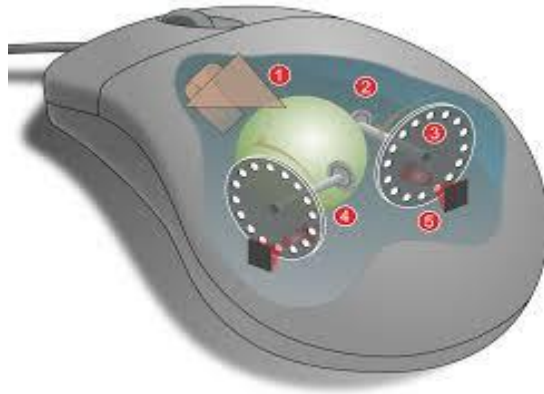
Laser Mouse

A **laser mouse** is a type of optical mouse that uses laser light to detect mouse movement.

Like all optical mice, the laser mouse has no moving parts inside. Laser is more accurate than the standard optical mouse design, providing for up to 20x greater sensitivity and precision.

This improved sensitivity and precision can be key for gaming applications and graphical or engineering design applications, where pinpoint accuracy is important

Mechanical and optical mice
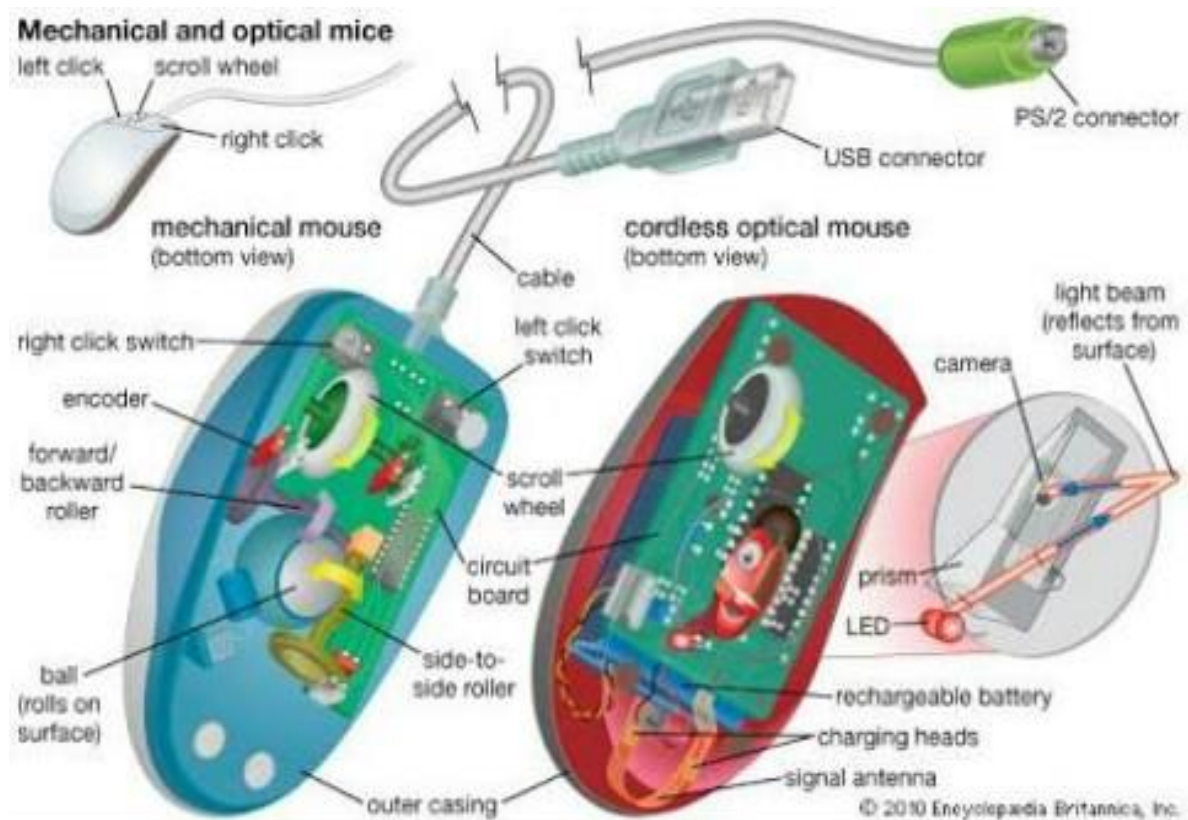
Scanner-Scanner is usually used to scan paper, images and books.

Flatbed Scanner

A flatbed scanner is made up of a glass pane and a moving optical CIS or CCD array. The pane is illuminated with the help of bright light planted underneath it. The image—the one that is to be scanned—is then placed on the glass pane. The sensor and source of light move across the glass pane to scan the document and produce its digital copy. If you want to scan transparent slides on your flatbed scanner, you will require a transparency adapter. Flatbed scanners derive their name from the fact that their glass plane or bed, where the object to be scanned is placed, is flat.

Sheetfed Scanner

As its name suggests, in this type of scanner, the document is fed into the horizontal or vertical slot provided in it. The prominent components of a sheetfed scanner include the sheet-feeder, scanning module, and calibration sheet. While the sensor and source of light move across the glass pane in flatbed scanners, in sheetfed scanners, they are stationary. Instead, the document moves through the scanner. Ideal for scanning single page documents, these scanners cannot scan thick objects, like books, and that, perhaps, is their major drawback.

Handheld Scanner

A handheld scanner is a small manual scanning device which is moved over the object that needs to be scanned. In flatback and sheet fed scanners, you put the document that is to be scanned inside the device. In contrast, in the case of hand held scanner, you have to drag it over the document that is to be scanned. Using a handheld scanner can be a cumbersome task as the hand needs to be steady all the time. Even a slight movement of hand can lead to distortion of the image. One of the most-utilized handheld scanner is the barcode scanner, typically used in shopping stores to valuate goods.

Drum Scanner

A drum scanner is the one which uses a photomultiplier tube (PMT) to scan images instead of the charge-coupled device that is typically used in a flatbed scanner. Photomultiplier tubes are vacuum tubes which are extremely sensitive to light. In drum scanners, the image is mounted on the glass tube. When the beam of light moves across the image, its reflection is picked up by the PMT and processed. Drum scanners are known for their high resolution, which makes them apt for detailed scans. If they are not as popular as flatbed scanners, it is because of their cost and large size.

Photo Scanner

As the name itself suggests, a photo scanner is mostly used to scan photographs. It has high resolution and color depth, both of which are necessary for scanning photographs. If you want to buy a scanner to digitize film negatives and slides, then the photo scanner is your best bet. While flatbed scanners can also scan your photographs for you, they are not as fast as dedicated photo scanners. It's also worth noting that the in-built software in some photo scanners helps in cleaning and restoring old photograph

Film Scanner

A film scanner is utilized to scan photographic films directly into a computer. The photographer has direct control over certain aspects, such as cropping, ratio of original image on the film, etc. Some film scanners available today have specialized software through which it is possible to minimize scratches and improve color quality. Low-end film scanners most often accept 35 mm film strips, while high-end scanners—armed with interchangeable film loaders—can accept 35 mm or 120 mm strips and even individual slides.

Portable Scanners

Being small in size, portable scanners can be easily carried around. Some of these are as small as your PDAs, hence, can be carried in the pockets. They are of great help when it comes to text document scanning. Their drawback though, is their limitation in terms of resolution. They cannot be used for scanning photographs or for applications which require high-resolution scanning.

**Image Quality Measurement in Scanner**

Resolution

The resolution of an image is determined by the number of individually addressable points (Pixels or dots) that make up the image, whether it is the number of pixels that make up a screen image, or the number of dots that make up a printed image.

The more dots that are used to create an image, then the more detail the image can resolve and the sharper it appears when viewed.

When using bitmap graphics, whatever resolution is chosen, information needs to be stored for each pixel or printer dot. This means the higher the resolution, the more information needs to be stored for an image of any given size.

Colour Depth
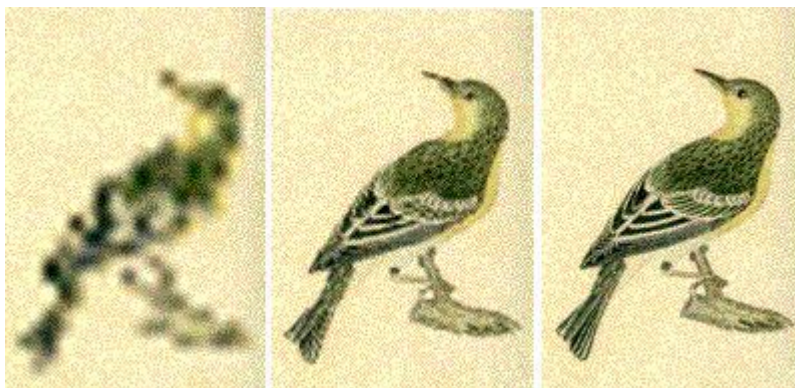
Colour depth is used to describe the maximum number of colours that are used in the image. The higher the number of colours then the more realistic the image will appear.

Working of Scanner

For modern scanners a Charge-coupled device [CCD] is used. A CCD sensor is used to capture the light from the scanner and then convert it into the proportional electrons. The charge developed will be more if the intensity of light that hits on the sensor is more.

Any scanner will have the following devices.

- Charge-coupled device (CCD) array
- Scan head
- Stepper motor
- Lens
- Power supply
- Control circuitry
- Interface ports
- Mirrors
- Glass plate
- Lamp
- Filters
- Stabilizer bar
- Belt
- Cover
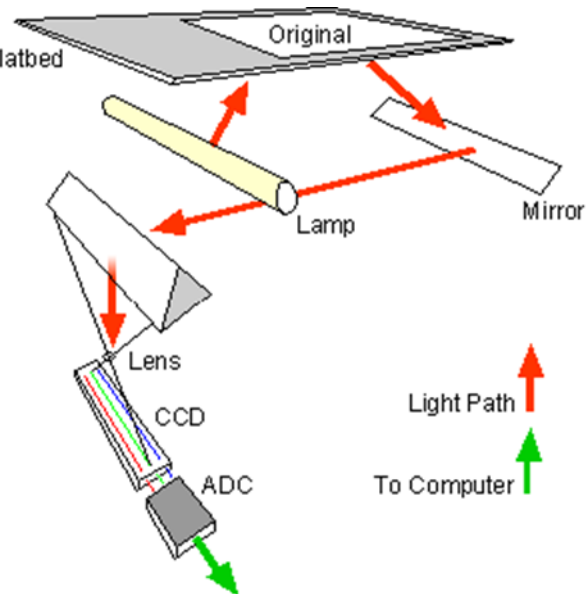
Though the configuration of the above components differs according to the manufacturers design the basic working is almost the same.

- 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.
- This cover may either be white or black in colour.
- This colour helps in providing uniformity in the background.

- This uniformity will help the scanner software to determine the size of the document to be scanned. If a page from a book is to be scanned, you may not be able to use the cover.

- 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. T
- 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.
- The scan head moves from one end of the machine to the other.
- When it has reached the other end the scanning of the document has been completed. For some scanners, a two-way scan is used in which the scan head has to reach its original position to ensure a complete scan.
- 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 focussed on CCD sensors. The CCD sensors convert the light to electrical signals according to its intensity.
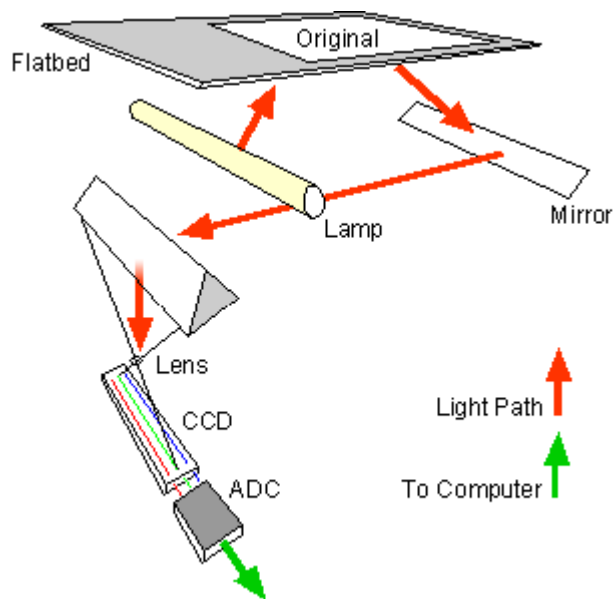
Step by step how scanner works

1. The image to be scanned is placed on top of the scanner's glass plate
2. The computer sends instructions to the logic board about how far the motor is to run and how fast
3. The logic board instructions place the scanning unit into an appropriate position to begin scanning
4. The scanning unit moves across the image to be scanned at a speed designated by the logic board instruction
5. As the scanning unit moves across the image, a light source shines on the image
6. The light strikes the image, reflects, and is then reflected by a series of mirrors to the scanner lens
7. The light passes through the scanner lens and reaches the CCD sensors
8. CCD sensors measure the amount of light reflected through the image and converts the light to an analog voltage
9. The analog voltage is changed to digital values by an ADC – analog to digital converter
10. The digital signals from the CCDs are sent to the logic board and transmitted back to the computer

The information is stored in the computer as an electronic file made up of pixels. The group of pixels is changed into a picture by the TWAIN scanning software. Black/White scanner only have one light source and colour scanner have three light sources (red, green. Blue).
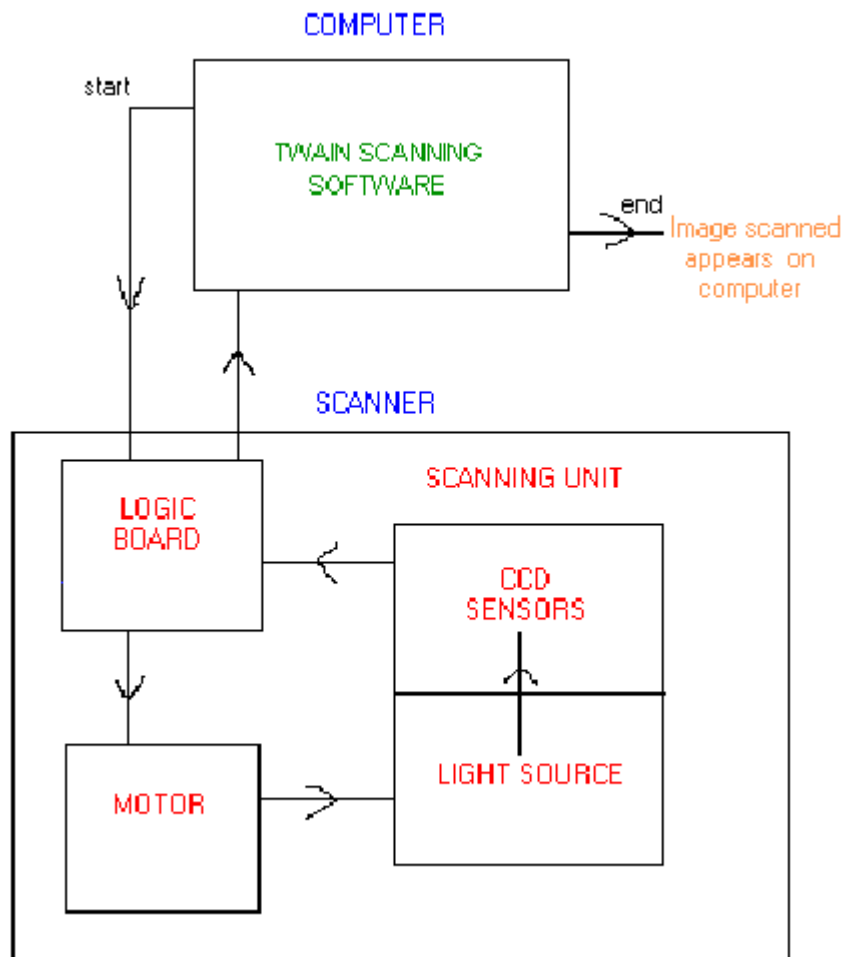
A Flow Chart of How a Scanner Works

Twain-TWAIN was an acronym is "technology without an important name. TWAIN is a widely-used program that lets you scan an image (using a scanner) directly into the application (such as PhotoShop) where you want to work with the image. Without TWAIN, you would have to close an application that was open, open a special application to receive the image, and then move the image to the application where you wanted to work with it. The TWAIN driver runs between an application and the scanner hardware. TWAIN usually comes as part of the software package you get when you buy a scanner.

Physical connection between the scanner and computer.

- **Parallel Connection**

This is one of the oldest method and the slowest method available. Though this type of connection is much economic it only had a data transfer rate of 70 kbps.

- **Small Computer System Interface [SCSI] Connection**

This method can be appropriate only with the help of an SCSI interface card. Earlier the scanners used to come with a dedicated SCSI card. Though the data transfer rate is high enough, much more economical and easier connections like the Firewire and USB came in its place.

- **Universal Serial Bus [USB] Connection**

USB connection is the latest and most economical method of data transfer. It has speeds up to 60 MBPS and can be easily connected to the scanner.

- **FireWire Connection**

This is the fastest of all the above methods. It has been introduced in the latest high-end scanners and is ideal for scanning high resolution images. It can transfer data at a maximum speed of 800 MBPS.

Printer-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

There are two types of printers.

- Impact printers
- Non-Impact printers

Impact printers

Daisy-wheel printers

In order to get the quality of type found on typewriters, a daisy-wheel impact printer can be used. It is called daisy-wheel printer because the print mechanism looks like a daisy; at the end of each "Petal" is a fully formed character which produces solid-line print. A hammer strikes a "petal" containing a character against the ribbon, and the character prints on the paper. Its speed is slow typically 25-55 characters per second.
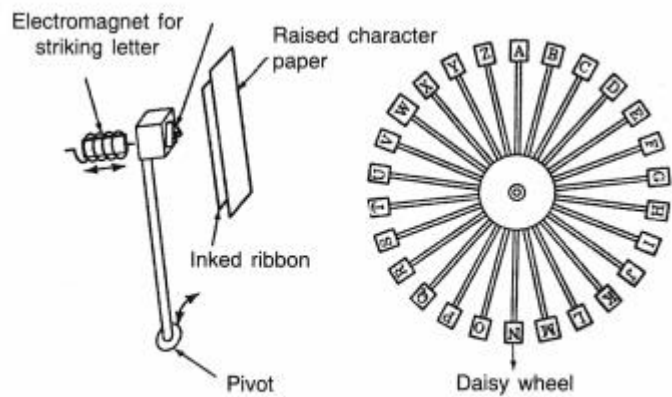
Daisy Wheel Printer

Fig. 2.20: Daisy Wheel Printer Mechanism
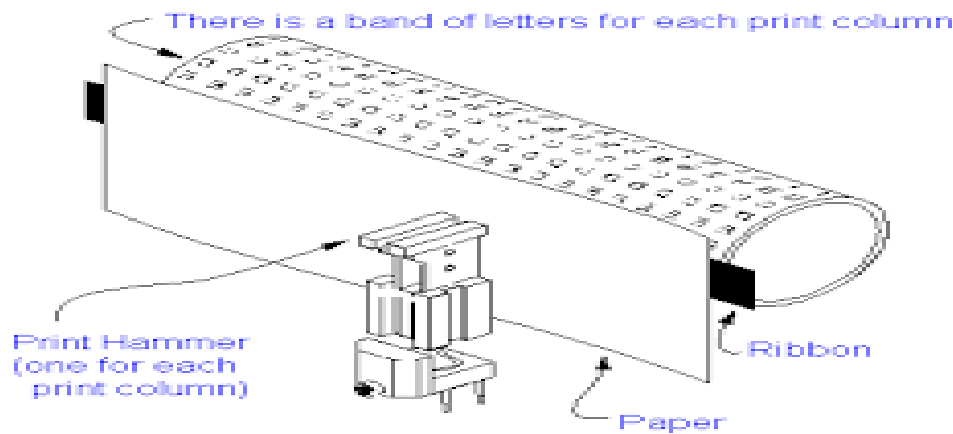
Line printers

In business where enormous amount of material are printed, the character-at-a-time printers are too slow; therefore, these users need line-at-a-time printers. Line printers, or line-at-a-time printers, use special mechanism that can print a whole line at once; they can typically print the range of 1,200 to 6,000 lines per minute. Drum, chain, and band printers are line-at-a-time printers.

Drum printer

A drum printer consists of a solid, cylindrical drum that has raised characters in bands on its surface. The number of print positions across the drum equals the number available on the page. This number typically ranges from 80-132 print positions. The drum rotates at a rapid speed. For each possible print position there is a print hammer located behind the paper. These hammers strike the paper, along the ink ribbon, against the proper character on the

drum as it passes. One revolution of the drum is required to print each line. This means that all characters on the line are not printed at exactly the same time, but the time required to print the entire line is fast enough to call them line printers. Typical speeds of drum printers are in the range of 300 to 2000 lines per minute.

Chain printers

A chain printer uses a chain of print characters wrapped around two pulleys. Like the drum printer, there is one hammer for each print position. Circuitry inside the printer detects when the correct character appears at the desired print location on the page. The hammer then strikes the page, pressing the paper against a ribbon and the character located at the desired print position. An impression of the character is left on the page. The chain keeps rotating until all the required print positions on the line have filled. Then the page moves up to print the next line. Speeds of chain printers range from 400 to 2500 characters per minute.

Non-impact printers

Non-impact printers do not use a striking device to produce characters on the paper; and because these printers do not hammer against the paper they are much quieter. Following are some non-impacted printers.

Ink-jet printers

Ink-jet printers work in the same fashion as dot-matrix printers in the form images or characters with little dots. However, the dots are formed by tiny droplets of ink. Ink-jet printers form characters on paper by spraying ink from tiny nozzles through an electrical field that arranges the charged ink particles into characters at the rate of approximately 250 characters per second. The ink is absorbed into the paper and dries instantly. Various colours of ink can also be used.

One or more nozzles in the print head emit a steady stream of ink drops. Droplets of ink are electrically charged after leaving the nozzle. The droplets are then guided to the paper by electrically charged deflecting plates [one plate has positive charge (upper plate) and the other has negative charge. A nozzle for black ink may be all that's needed to print text, but full-colour printing is also possible with the addition of needed to print text, but full-colour printing is also possible with the addition three extra nozzles for the cyan, magenta, and yellow primary colours. If a droplet isn't needed for the character or image being formed, it is recycled back to its input nozzle.

Several manufacturers produce colour ink-jet printer. Some of these printers come with all their colour inks in a cartridge; if you want to replace on colour, you must replace all the colours. Other colour ink-jet printers allow you to replace ink individually. These printers are a better choice if user uses one colour more than other colours. These printers produce less noise and print in better quality with greater speed.
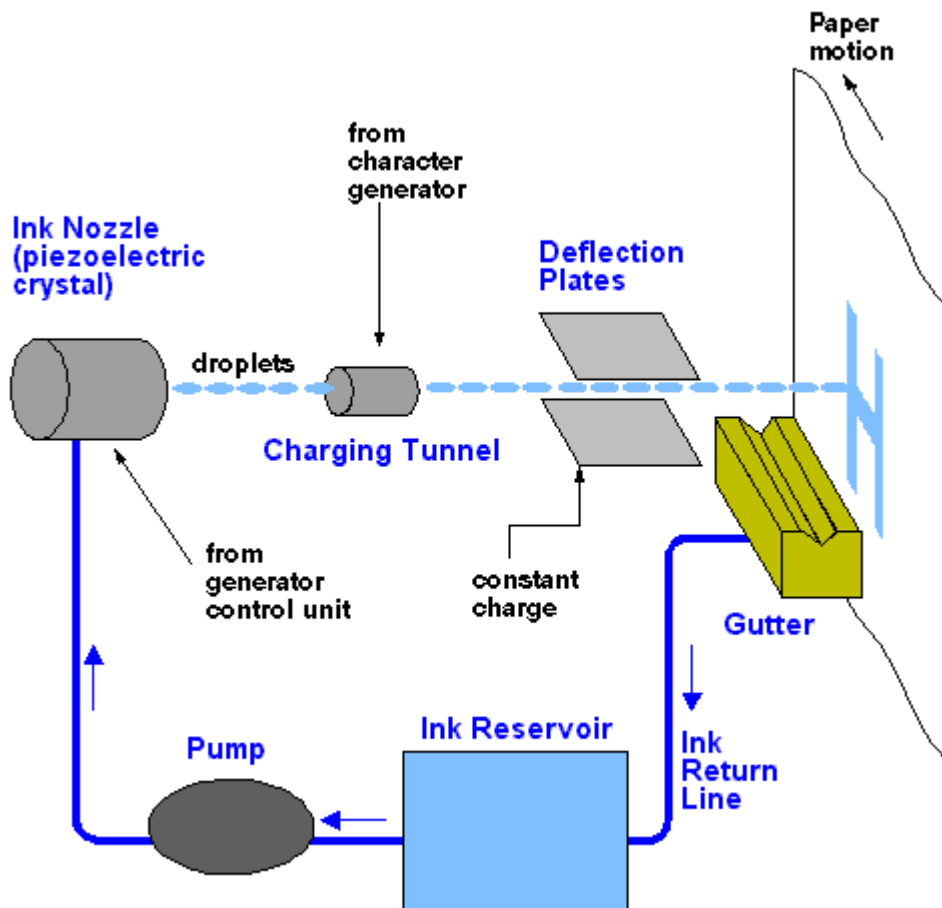
Laser printers

A laser printer works like a photocopy machine. Laser printers produce images on paper by directing a laser beam at a mirror which bounces the beam onto a drum. The drum has a special coating on it to which toner (an ink powder) sticks. Using patterns of small dots, a laser beam conveys information from the computer to a positively charged drum to become neutralized. From all those areas of drum which become neutralized, the toner detaches. As the paper rolls by the drum, the toner is transferred to the paper printing the letters or other graphics on the paper. A hot roller bonds the toner to the paper.

Laser printers use buffers that store an entire page at a time. When a whole page is loaded, it will be printed. The speed of laser printers is high and they print quietly without producing much noise. Many home-use laser printers can print eight pages per minute, but faster and print approximately 21,000 lines per minute, or 437 pages per minute if each page contains 48 lines. When high speed laser printers were introduced they were expensive. Developments in the last few years have provided relatively low-cost laser printers for use in small businesses.

Working of laser Printer

- A laser printer produces a printed document using a focused beam of laser light and a rotating mirror to reproduce the image of a document as an electrostatic charge on a photosensitive drum
- Ink of the laser printer is added and the charge on the drum attracts and holds it in the image of the document
- Paper is rolled over the drum and picks up the toner
- Heat is then applied to the toner, it fuses with the paper and the document is completed and placed on the output rack of the printer

Advantages of Laser Printer

- The main advantage of Laser printer is its speed & efficiency at which it prints high-quality quality graphics & text.
- Laser printers produce high-quality output as compared to other printers.
- Laser printers are quite and does not produce disturbing sounds.
- They are also capable to produce colour prints.

Disadvantages of Laser Printer

- The main disadvantage of Laser printer is its cost, they are relatively costly as compared to other printers.
- The maintenance, repair & servicing charges are also high of these printers.
- Laser printers emit small amount of ozone and are hazardous to health and the atmosphere.

  The seven steps of laser printing are:
  1- **Processing-**The computer sends the data to the printer.
  2- **Charging-**The PRIMARY CORONA WIRE charges the PHOTOCONDUCTIVE drum to 600 to 1000 volts DC.
  3-**Exposing-**The LASER SCANS or PAINTS the image to the drum. Anywhere the laser touches the drum causes the electrical charge to DRAIN OFF.
  4- **Developing-**NEGATIVELY CHARGED toner particles are allowed to attach to the PAINTED AREA of the drum; as the negative charge has been drained off these areas.

5- Transferring-The TRANSFER CORONA WIRE charges the paper with a POSITIVE CHARGE from behind. The NEGATIVELY CHARGED toner jumps to the positive paper, according to the image on the drum.

A STATIC CHARGE ELIMINATOR then removes any residual charge.

6- Fusing-The toner particles attached to the paper are FUSED or MELTED to the paper, usually with a heated drum.

7- Cleaning-The drum is cleaned of excessive toner and electrical charges.

Step-by-step

1. The moment you press print on your computer, tablet or mobile device the information is sent to the printer memory, where the data is stored.

2. The printer begins to warm up. This is the point where you usually need to wait and it's because the corona wire is heating up and getting ready to pass its positive static charge to the drum.

3. As the drum (coated metal cylinder) begins to roll, it received a positive charge across its whole surface. Some printers contain 4 drums, one for each colour – Cyan, Magenta, Yellow & Black.

4. The laser activates, and beams against a series of mirrors to reflect across the surface of the drum(s) imprinting the shape of your print using an opposite negative electrical charge.

5. The toner cartridge and hopper, sat next to the drum(s) slowly releases positively charged carbon toner particles on to the drum as it turns and the toner is attracted to any areas of negative charge leaving positively charged areas of the drum untouched.

6. The transfer belt rolls the paper through the printer giving it a positive charge, and as it passes the drum, the negatively charged toner is attracted to the page in the shape of your print.

7. The toner is then melted to the paper by hot rollers called the fuser unit, your page is printed!
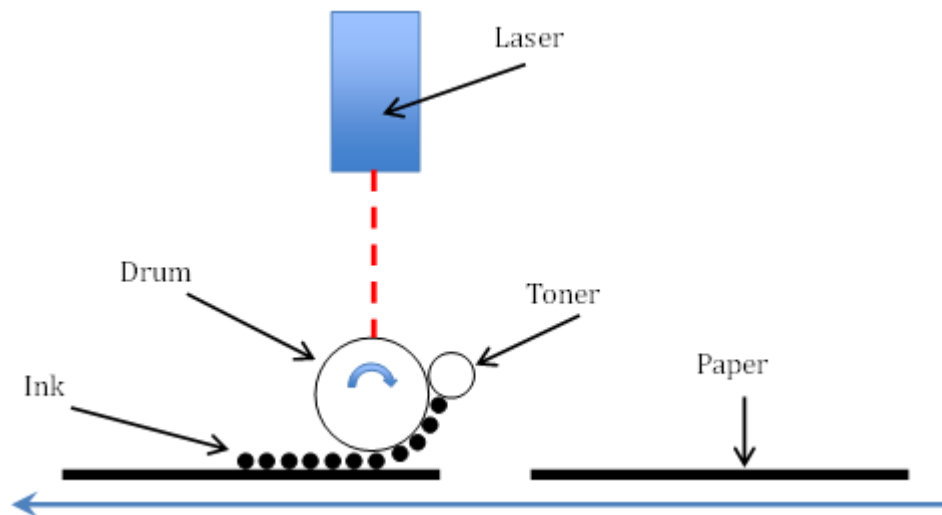
Working of Laser Printer

Basic Laser Printer Components