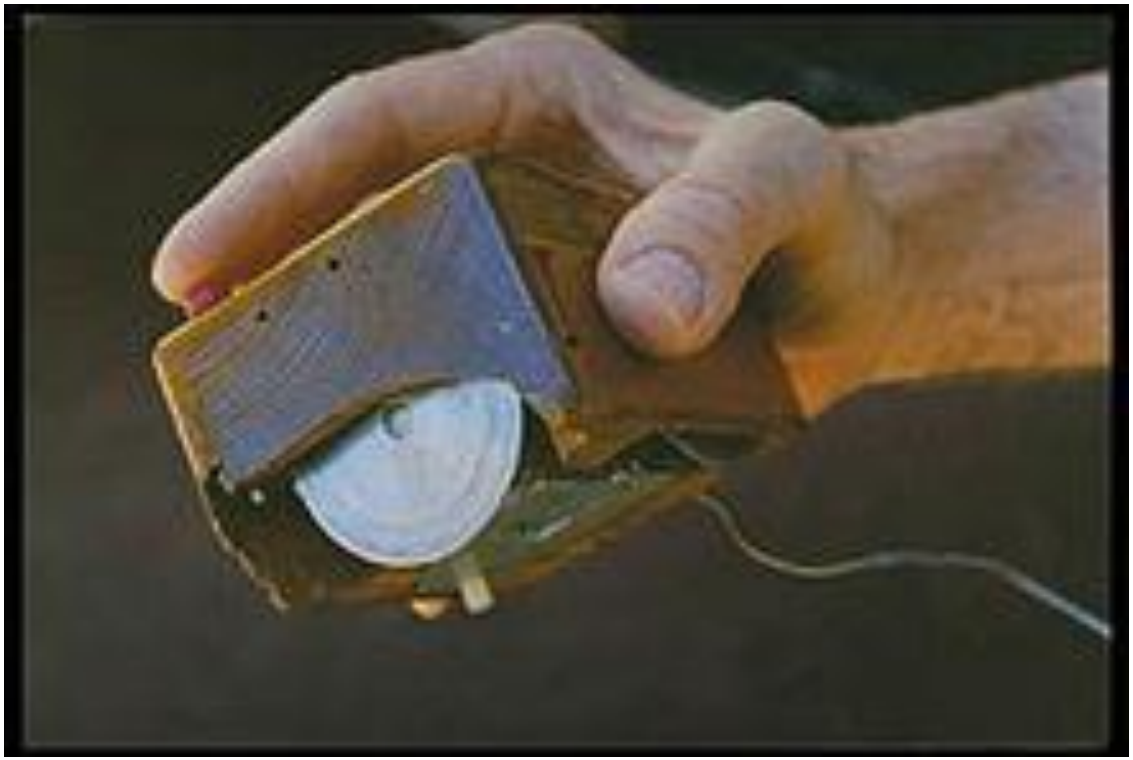
Input /Output Devices

Point-and-draw devices

- A pointing & draw device is a hardware input device that allows the user to move the mouse pointer. Good examples of pointing devices are a computer mouse, trackball, light pens, touchpad.
- A pointing device is an external tool that is used to move objects around and also to select options from menus.

Computer mouse

A **computer mouse** is a pointing device (hand control) 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 for fine control of a graphical user interface.



Mechanical mouse

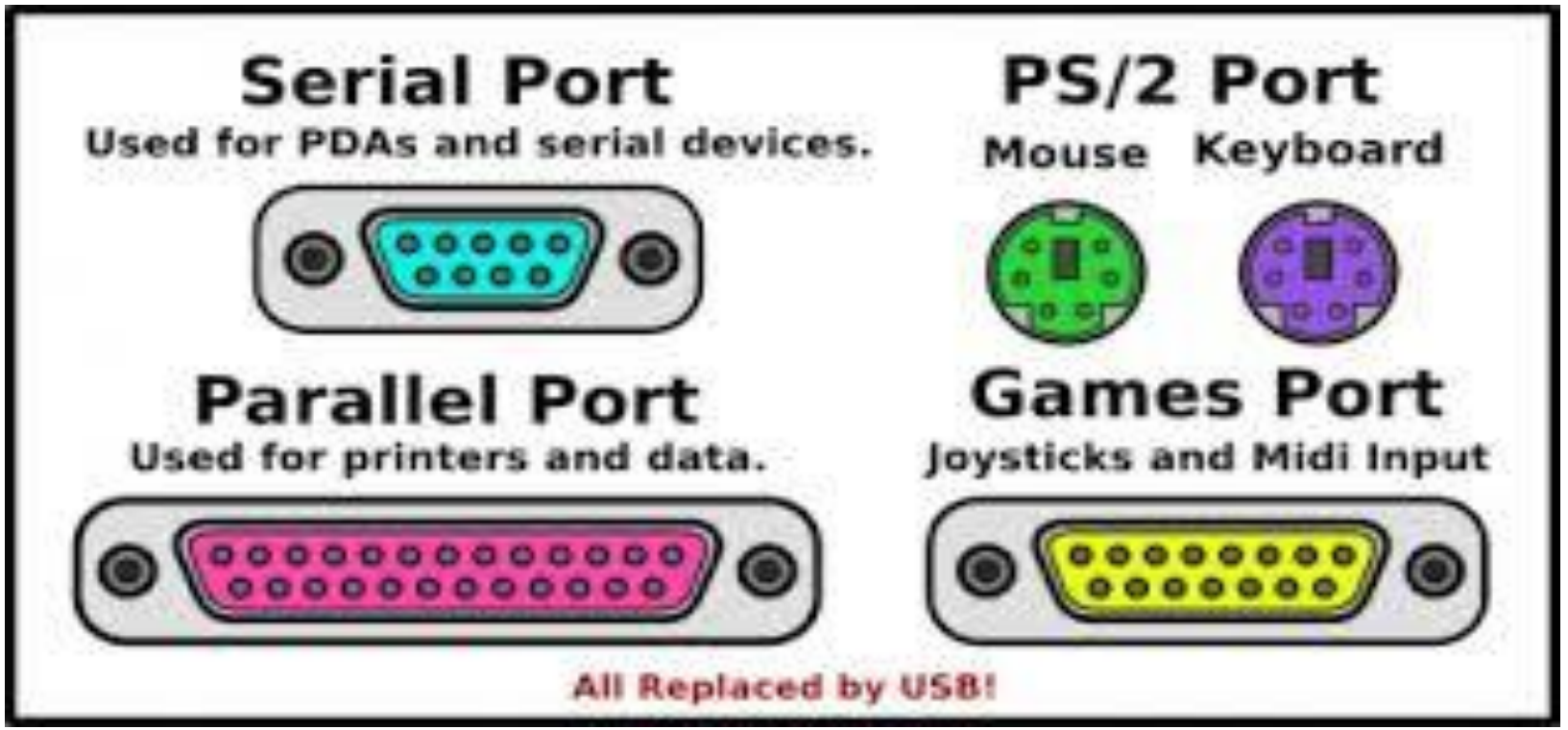
- The ball mouse has two freely rotating rollers. They are located 90 degrees apart. One roller detects the forward–backward motion of the mouse and other the left–right motion.
- Each wheel of the mouse is connected to a sensor. Simple logic circuits interpret the relative timing to indicate which direction the wheel is rotating as the mouse moves on a surface.
- The ball is mostly steel, with a precision spherical rubber surface. The weight of the ball, given an appropriate working surface under the mouse, provides a reliable grip so the mouse's movement is transmitted accurately. **********

Mechanical Mouse

- **Optical and laser mouse**
- Optical mouse rely entirely on one or more light-emitting diodes (LEDs) and a built-in photo detector to detect movement relative to the underlying surface, avoiding the internal moving parts a mechanical mouse uses in addition to its optics. A laser mouse is an optical mouse that uses coherent (laser) light.
- The earliest optical mouse detected movement on pre-printed mouse pad surfaces, whereas the modern LED optical mouse works on most opaque diffuse surfaces; it is usually unable to detect movement on surfaces like polished stone. Laser diodes are also used for better resolution and precision, improving performance on polished stone opaque surfaces.

- Modern optical mice able to work on almost any surface, the mouse has a small, red **light-emitting diode** (LED) that bounces light off that surface onto a complementary metal-oxide semiconductor (CMOS) sensor.
- The CMOS sensor sends each image to a **digital signal processor (DSP)** for analysis. The DSP, operating at 18 MIPS (million instructions per second), is able to detect patterns in the images and see how those patterns have moved since the previous image. Based on the change in patterns over a sequence of images, the DSP determines how far the mouse has moved and sends the corresponding coordinates to the computer. The computer moves the cursor on the screen based on the coordinates received from the mouse. This happens hundreds of times each second, making the cursor appear to move very smoothly.

- Bus Mouse
- Serial Mouse
- PS/2 Mouse
- USB Mouse
- Wireless Mouse


Serial Port
Used for PDAs and serial devices.
PS/2 Port
Mouse
Keyboard
Parallel Port
Used for printers and data.
Games Port
Joysticks and Midi Input
All Replaced by USB!

- Devices That Use Parallel Ports

  zip drives, scanners, joysticks, external hard drives and webcams

- Devices That Use Serial Ports

  flat screen monitors, GPS receivers, bar code scanners and satellite phones or modems.

- USB mose
- Wired and cordless mouse.

Trackball

- track ball is a pointing device consisting of a ball held by a socket containing sensors to detect a rotation of the ball about two axes—like an upside-down mouse with an exposed protruding ball.

- The user rolls the ball with the thumb, fingers, or the palm of the handto move a pointer.
- Compared with a mouse, a trackball has no limits on effective travel; at times, a mouse can reach an edge of its working area while the operator still wishes to movethe screen pointer farther. With a trackball, the operator just continues rolling, whereas a mouse would have to be lifted and re-positioned. Some trackballs have notably low friction.
- Track ball comes in various shapes .The commonly used shapes are Ball, Button ,Square.

USES

- Large trackballs are common on CAD workstations for easy precision.
- Before the advent of the touchpad, small trackballs were common on portable computers, where there may be no desk space on which to run a mouse

Joystick

- A **joystick** is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling.
- **It's a pointn device that works on the same principle as track ball.**
- **To make the movements on spherical bar easier ,it is placed on socket and a stick mounted on it.Most joysticks use potentiometers to sense stick and ball movements**

- Joysticks are often used to control video games, and usually have one or more push-buttons whose state can also be read by the computer.
- Joysticks are also used for controlling machines such as cranes, trucks, underwater unmanned vehicles, wheelchairs, surveillance cameras, and zero turning radius lawn mowers.
- Miniature finger-operated joysticks have been adopted as input devices for smaller electronic equipment such as mobile phones.
- **********

Electronic Pen

Light pen:

- It uses photoelectric cell and an optical lense mounted in a pen shaped case to focus on to it any light in its field of view.
- It can detect the light emitted fro a limited field of view of the monitors display.
- A **light pen** used with computer's CRT display.
- CAD uses light pen

Writing pen with a pad (digital pen):-

The user writes on the pad with electronic pen and handwriting recognition software often enables easy input of text and freehand drawings into computer.

Touch Screen

- The touchscreen enables the user to interact directly with what is displayed, rather than using a mouse, touchpad, or any other intermediate device (other than a stylus, which is optional for most modern touchscreens).
- Touchscreens are common in devices such as game consoles, personal computers, tablet computers, electronic voting machines, and smartphones
- They can also be attached to computers or, as terminals, to networks. They also play a prominent role in the design of digital appliances such as personal digital assistants (PDAs)

- **Resistive:** A resistive touch screen panel is coated with a thin metallic electrically conductive and resistive layer that causes a change in the electrical current which is registered as a touch event and sent to the controller for processing. Resistive touch screen panels are generally more affordable but offer only 75% clarity and the layer can be damaged by sharp objects. Resistive touch screen panels are not affected by outside elements such as dust or water.

- **Surface wave:** Surface wave technology uses ultrasonic waves that pass over the touch screen panel. When the panel is touched, a portion of the wave is absorbed. This change in the ultrasonic waves registers the position of the touch event and sends this information to the controller for processing. Surface wave touch screen panels are one of the most advanced types, but they can be damaged by outside elements.
-
-

- **Capacitive:** A capacitive touchscreen panel consists of an insulator such as glass, coated with a transparent conductors that stores electrical charges. When the panel is touched, a small amount of charge is drawn to the point of contact because the human body is a conductor . Circuits located at each corner of the panel measure the charge and send the information to the controller for processing. Capacitive touch screen panels must be touched with a finger unlike resistive and surface wave panels that can use fingers and stylus. Capacitive touch screens are not affected by outside elements and have high clarity.

Optical imaging

- Optical touchscreens are a relatively modern development in touchscreen technology, in which two or more image sensors are placed around the edges (mostly the corners) of the screen. Infrared back lights are placed in the camera's field of view on the other side of the screen. A touch shows up as a shadow and each pair of cameras can then be pinpointed to locate the touch or even measure the size of the touching object (see visual hull). This technology is growing in popularity, due to its scalability

- **Infrared grid**
- An infrared touchscreen uses an array of X-Y infrared LED and photodetector pairs around the edges of the screen to detect a disruption in the pattern of LED beams. These LED beams cross each other in vertical and horizontal patterns. This helps the sensors pick up the exact location of the touch. A major benefit of such a system is that it can detect essentially any input including a finger, gloved finger, stylus or pen.

Data Scanning Devices:-

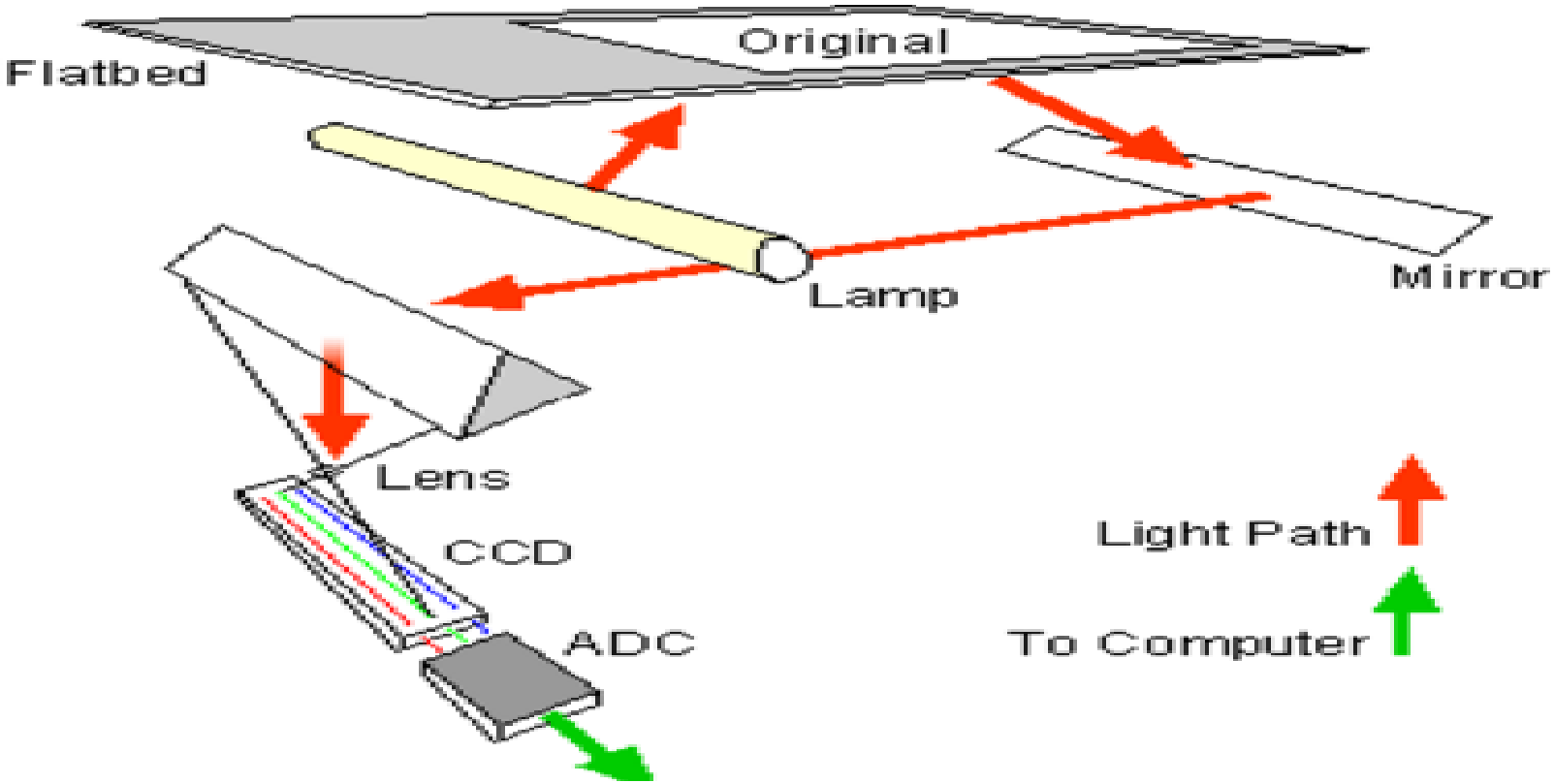
Eliminate the need of manual entry of data , improving data accuracy and timeliness of data processed.

The demand high quality of source document.

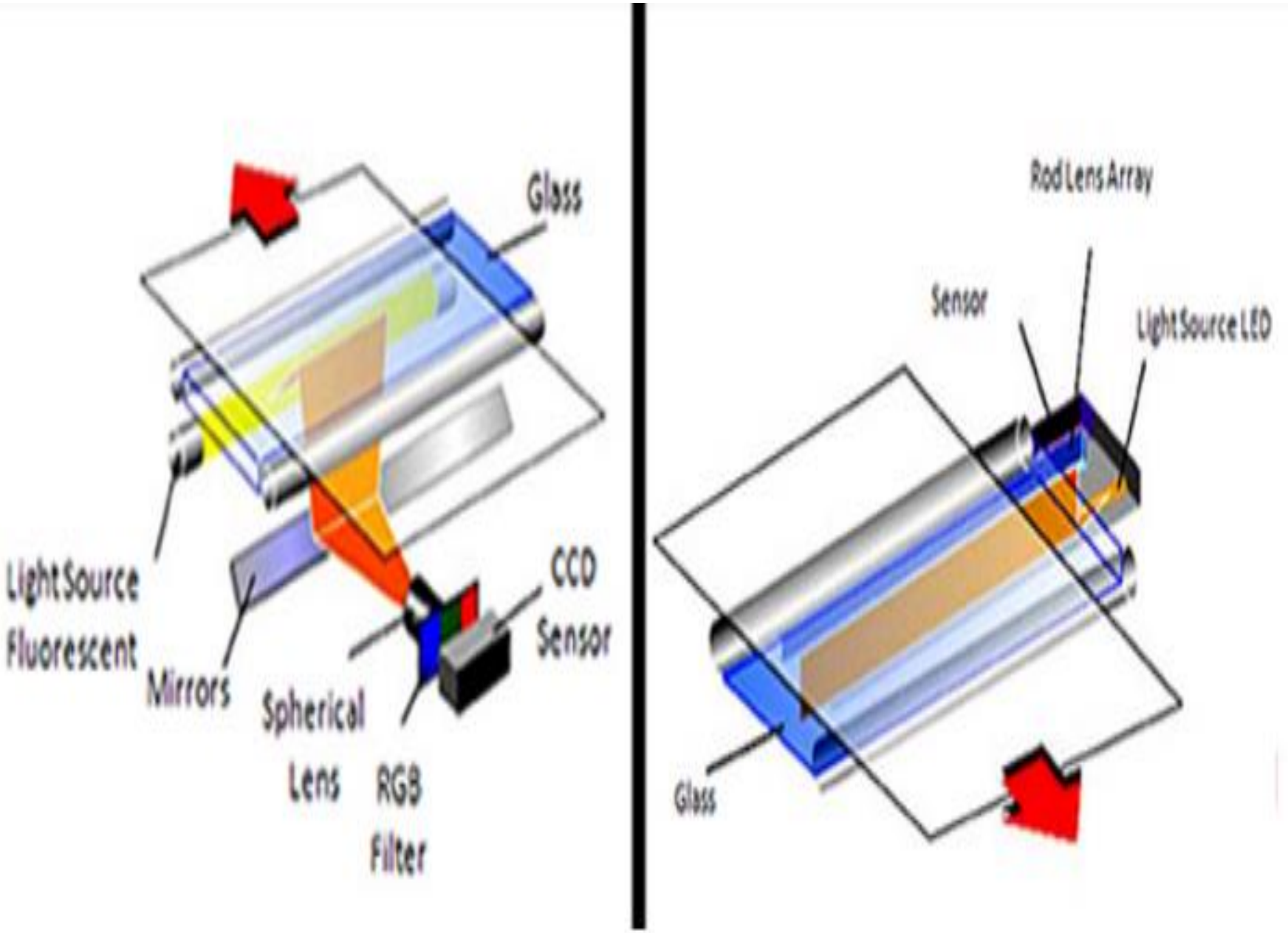
- Image Scanners

Flatbed

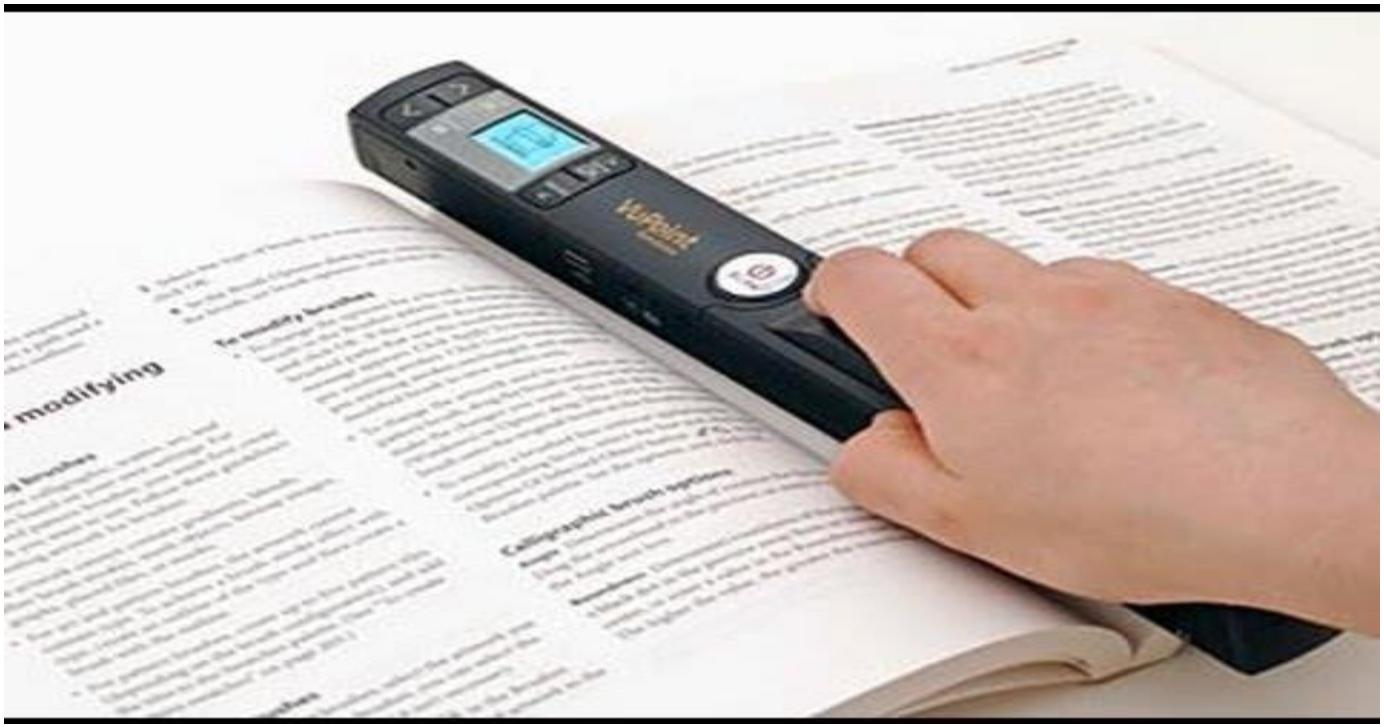
- This type of scanner is sometimes called reflective scanner because it works by shining white light onto the object to be scanned and reading the intensity and color of light that is reflected from it, usually a line at a time. They are designed for scanning prints or other flat, opaque material
  - **CCD scanner**
    - "A flatbed scanner is usually composed of a glass pane (or platen), under which there is a bright light (often xenon, LED or cold cathode fluorescent) which illuminates the pane.


Flatbed
Original
Lamp
Mirror
Lens
CCD
ADC
Light Path
To Computer

- **CIS scanner**
  - Contact image sensor (CIS) scanning consists of a moving set of red, green and blue LEDs strobes(lights up) for illumination
  - Contact image sensor (CIS) scanning consists of a moving set of red, green and blue LEDs array for illumination.The reflected from the original is gathered by a lens and directed at an image sensor array that rests just under the document being scanned.The sensor then records the images according to the intensity of light that hits the sensor.


Glass
Light Source
Fluorescent
Mirrors
Spherical
Lens
RGB
Filter
CCD
Sensor
Rod Lens Array
Sensor
Light Source LED
Glass

- **Handheld scanners** use the same basic technology as a flatbed scanner, but rely on the user to move them instead of a motorized belt. This type of scanner typically does not provide good image quality. However, it can be useful for quickly capturing text



Drum Scanner

- A high-end optical scanning device used to convert an image—such as a photograph—to digital form.
- In a drum scanner, the original image (usually a color transparency) is attached to a transparent revolving drum—or cylinder—while a small point of light illuminates the image from within the drum, the relected light is split, passed through red, green and blue filters, and picked up by a photomultiplier tube,, which analyzes each row, pixel by pixel, storing the particular color digital file.
- When one revolution is complete, the light source moves one pixel to the side, and images the next row, continuing this process until the entire picture is imaged.
- In the photomultiplier tube, the amounts image are derived from the amounts of red, green, and blue light hitting it.

Optical Scanners

OCR devices:

- Image scanners produces the image instead of text.,it is not possible to do any word processing o the document.
- Storage requirement is also high for images than text.
- Optical character recognition (OCR) software works with your scanner to convert printed characters into digital text, allowing you to search for or edit your document in a word processing program.
- The scanner uses a Character Recognition Software which convert bitmap images to equivalent computer codes.
- The job of OCR software is to translate that array of dots into text that the computer can interpret as letters and numbers.

- To translate OCR software examines the bit map of each character and compares with pre programmmed set of characters, which the machine can recognize.
- It cannot support unlimitted number of fonts,(only OCR types)
- Two fonts, OCR A and OCR B fonts have done major contribution towards significant technology improvement in OCR
- Best font size is 10 to 12 points and using smaller font sizes in international localization have generated bad OCR recognition. Font sizes greater than 72 must be avoided as the characters are treated as images rather than text.

- **OMR**
- **Optical mark recognition** (also called **optical mark reading** and **OMR**) is the process of capturing human-marked data from document forms such as surveys and tests.

Bar code Reader

A **barcode** is an optical machine-readable representation of data relating to the object to which it is attached. Originally barcodes systematically represented data by varying the widths and spacings of parallel lines, and may be referred to as linear or one-dimensional

Usually represent Alpha numeric data

Types of Barcode Readers:

- **Pen**
  - Pen barcode readers resemble small wand-type sticks that resemble a small pen. The pen-style barcode reader consists of an LED light and a photodiode in its tip.
  - The user passes this tip over a barcode and the LED light illuminates the black and white bars. The photodiode measures the reflection of light and is able to determine width and color (white or black) of each bar.
  - This information allows for a digital reading of the barcode, and information is transmitted to another unit for processing.

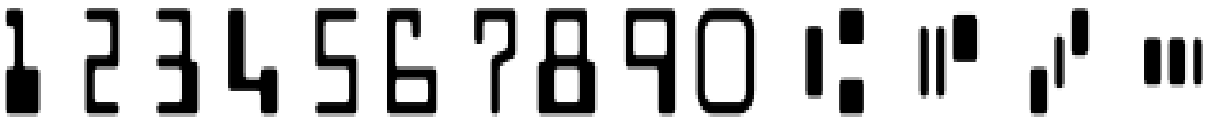
- **Laser**
- Slightly more advanced than a pen scanner, a laser barcode scanner is capable of more exact light readings which prevent false positives or scanner errors.
- In a laser scanner, a laser beam is shot at a mirror inside the actual unit.
- This mirror makes a movement so that the laser sweeps across the barcode in a straight line.
- This light then reflects back to a diode, which measures the level of reflection. This reflection is translated into a digital signal readout of the barcode.
- Laser scanners can either be mounted in a scanning unit or be part of a handheld unit.

- **CCD**
- A charge coupled device (CCD), also known as an LED scanner, features hundreds of tiny LED lights arranged in one long row. These lights are shot directly onto a barcode, and a sensor then measures not the reflection, but voltage of the ambient light directly in front of each light bulb.
- This voltage measurement provides a digital snapshot of the barcode.
- CCD units can be very expensive, but are highly accurate and versatile pieces of equipment.

- **2D Camera**
- Some barcodes do not consist of white and black bars, but white and black spaces in a two-dimensional (2D) target. These 2D barcodes cannot be read by standard machinery, but they do allow for versatility of information coding as they can hold and provide much more data than a standard barcode. To read these barcodes, a 2D camera image scanner is necessary. This camera consists of hundreds of tiny lights like the CCD scanner, but these are arranged in multiple rows. The lights flash onto the barcode and take a digital picture of the barcode, which is then sent to software as a digital signal. The software then decodes the information.

MICR

- **Magnetic Ink Character Recognition Code** (**MICR Code**) is a character-recognition technology used mainly by the banking industry to ease the processing and clearance of cheques and other documents. The MICR encoding, called the *MICR line*, is at the bottom of cheques and other vouchers and typically includes the document-type indicator, bank code, bank account number, cheque number.
- There are two major MICR fonts in use: E-13B and CMC-7. E-13B has a 14 character set,[2] while CMC-7 has 15—the 10 numeric characters, plus control characters.



The 14 characters of the E-13B font. The control characters bracketing each numeral block are (from left to right) *transit*, *on-us*, *amount*, and *dash*.

An example of the CMC-7 MICR font. Shown are the 15 characters of the CMC-8 font. The control characters after the numerals are (from left to right) *internal*, *terminator*, *amount*, *routing*, and an unused character.

- MICR characters are printed on a document in either of the MICR fonts. The ink used in the printing is a magnetic ink or toner, usually containing iron oxide.
- The MICR text is passed before a MICR reader. The ink in the plane of the paper is first magnetized.
- Then the characters are passed over a MICR read head, a device similar to the playback head of a tape recorder.
- As each character passes over the head it produces a unique waveformthat can be easily identified by the system.

Magnetic Stripe Card

- A **magnetic stripe card** is a type of card capable of storing data by modifying the magnetism of tiny iron-based magnetic particles on a band of magnetic material on the card. The magnetic stripe, sometimes called **swipe card** or **magstripe**, is read by swiping past a magnetic reading head. Magnetic stripe cards are commonly used in credit cards, identity cards,

Microphone

The **condenser microphone**, **capacitor microphone** or **electrostatic microphone**—capacitors were historically called condensers.

Here, the diaphragm acts as one plate of a capacitor, and the vibrations produce changes in the distance between the plates.

The capacitance of the plates is inversely proportional to the distance between them for a parallel-plate capacitor.

- Dynamic microphone

- A small movable induction coil, positioned in the magnetic field of a permanent magnet, is attached to the diaphragm. When sound enters through the windscreen of the microphone, the sound wave moves the diaphragm. When the diaphragm vibrates, the coil moves in the magnetic field, producing a varying current in the coil through electromagnetic induction. A single dynamic membrane does not respond linearly to all audio frequencies. Some microphones for this reason utilize multiple membranes for the different parts of the audio spectrum and then combine the resulting signals

- A **crystal microphone** or **piezo microphone**[25] uses the phenomenon of piezoelectricity—the ability of some materials to produce a voltage when subjected to pressure—to convert vibrations into an electrical signal. An example of this is potassium sodium tartrate, which is a piezoelectric crystal that works as a transducer, both as a microphone and as a slimline loudspeaker component

- MIDI

- **MIDI** short for **Musical Instrument Digital Interface**) is a technical standard that describes a protocol, digital interface and connectors and allows a wide variety of electronic musical instruments, computers and other related devices to connect and communicate with one another.
- MIDI (Musical Instrument Digital Interface) is a protocol designed for recording and playing back music on digital synthesizers
- MIDI carries event messages that specify notation, pitch and velocity, control signals for parameters such as volume.
- Rather than representing musical sound directly, it transmits information about how music is produced.

MIDI Devices

- The basic logical groups of MIDI devices :
  - Synthesizers
  - Controllers
  - Sequencers

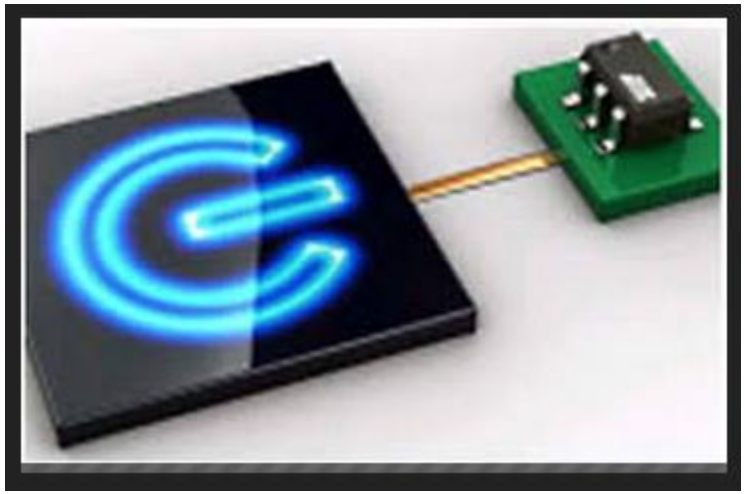
- **MIDI Synthesizers**
- Synthesizers are devices that electronically synthesize sound. In our case we are synthesizing music but it could just as easily be a dog barking or an explosion that is triggered by our incoming MIDI data.
- There are several varieties of synthesizers based on the technology they use to imitate musical instruments.

- **MIDI Controllers**
- The starting point for most MIDI data is you. You generate the MIDI data by playing a MIDI device like a keyboard that generates MIDI data representing your actions while playing. Any device that does this is called a MIDI controller.
- The most common type of MIDI controller is a MIDI keyboard but there are many types.
- **MIDI Sequencers**
- MIDI sequencers get their name from their ability to record sequences of MIDI messages and play them back. They also allow you to make changes to the sequence of MIDI messages so what plays back is different than what was recorded.

Sensors

- A normal PC has no way of knowing what is happening in the real world around it. It doesn't know if it is light or dark, hot or cold, quiet or noisy. How do we know what is happening around us? We use our eyes, our ears, our mouth, our nose and our skin - our **senses**.
- A normal PC has no senses, but we can give it some: We can connect sensors to it…
- A **sensor** is a device that **converts** a **real-**world property (e.g. temperature) into **data** that a computer can **process**.

Sensor	What it Detects
Temperature	Temperature
Light	Light / dark
Pressure	Pressure (e.g. someone standing on it)
Moisture	Dampness / dryness
Water-level	How full / empty a container is
Movement	Movement nearby
Proximity	How close / far something is
Switch or **button**	If something is touching / pressing it



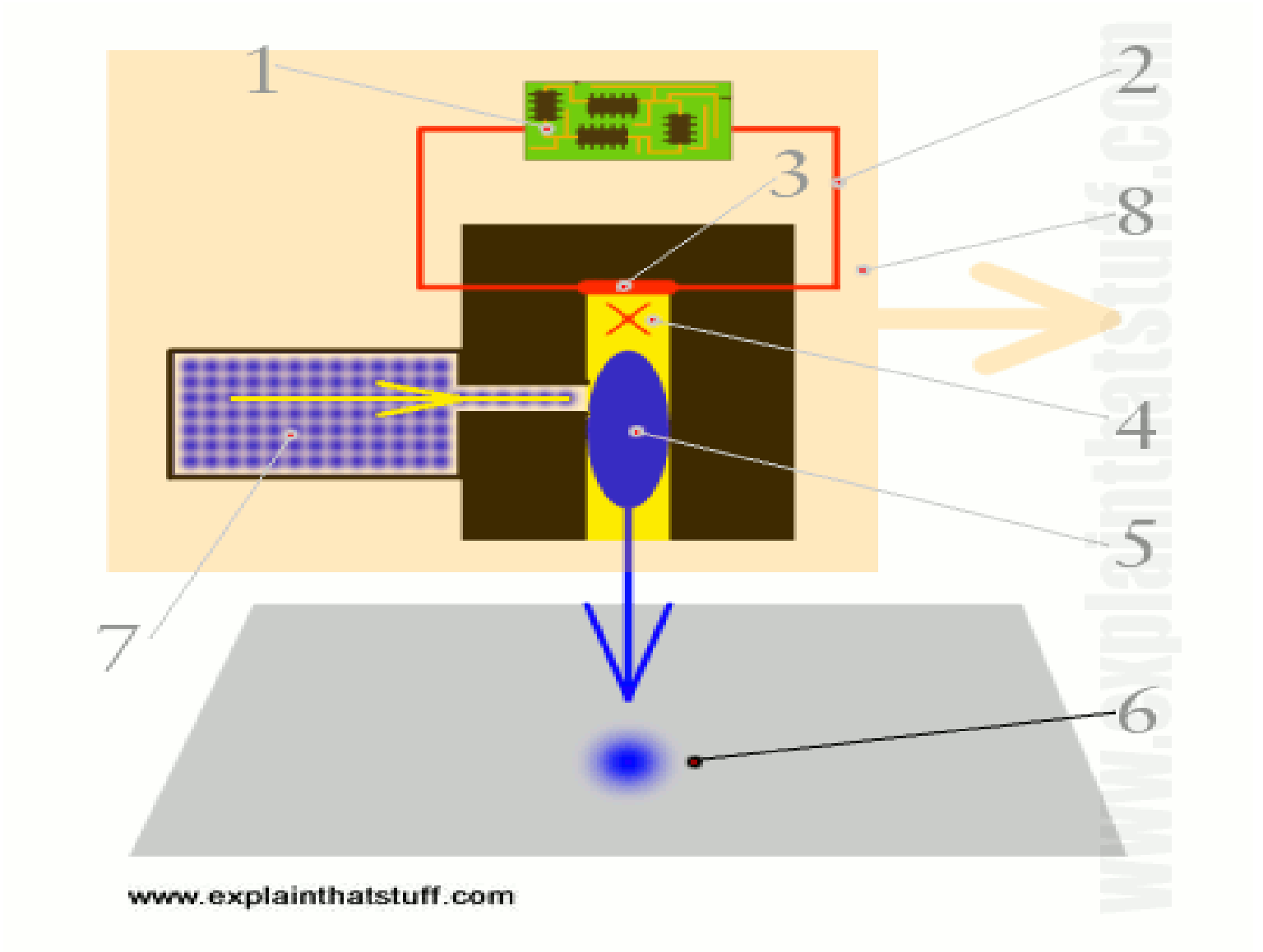
Printers

- **Inkjet printing** is a type of computer printing that recreates a digital image by propelling droplets of ink onto paper, plastic, or other substrates.[1] Inkjet printers are the most commonly used type of printer,[2] and range from small inexpensive consumer models to expensive professional machines
- Inkjet printers were really an evolution of dot-matrix printers. Instead of metal needles, they use hundreds of tiny guns to fire dots of ink at the paper instead. The characters they print are still made up of dots, just like in a dot-matrix printer, but the dots are so very tiny that you cannot see them.

- Different types of inkjet printer fire the ink in various ways.
- In Canon printers, the ink is fired by heating it so it explodes toward the paper in bubbles. This is why Canon sells its printers under the brand name "Bubble Jet.“
- Epson printers work a slightly different way. They use an effect called piezoelectricity. Tiny electric currents controlled by electronic circuits inside the printer make miniature crystals jiggle back and forth, firing ink in jets as they do so.
- You can think of inkjet printers very simply as a firing squad of nozzles firing millions of dots of ink at the paper every single second!

1. Under instructions from your computer, an electronic circuit in the printer figures out which nozzles have to be fired to print a particular character at a certain point on the page. Hundreds of nozzles are involved in making a single character and each one is only about a tenth as thick as a human hair!
2. The circuit activates each of the nozzles by passing an electric current through a small resistor inside it.
3. When electricity flows through the resistor, it heats up.
4. Heat from the resistor boils the ink inside the nozzle immediately next to it.

1. As the ink boils, it forms into a bubble of ink vapor. The bubble expands enormously and bursts.
2. When the bubble pops, it squirts the ink it contained onto the page in a precisely formed dot.
3. The collapsing bubble creates a partial vacuum in the nozzle that draws in more ink from the ink tank, ready for printing the next dot.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Laser Printer

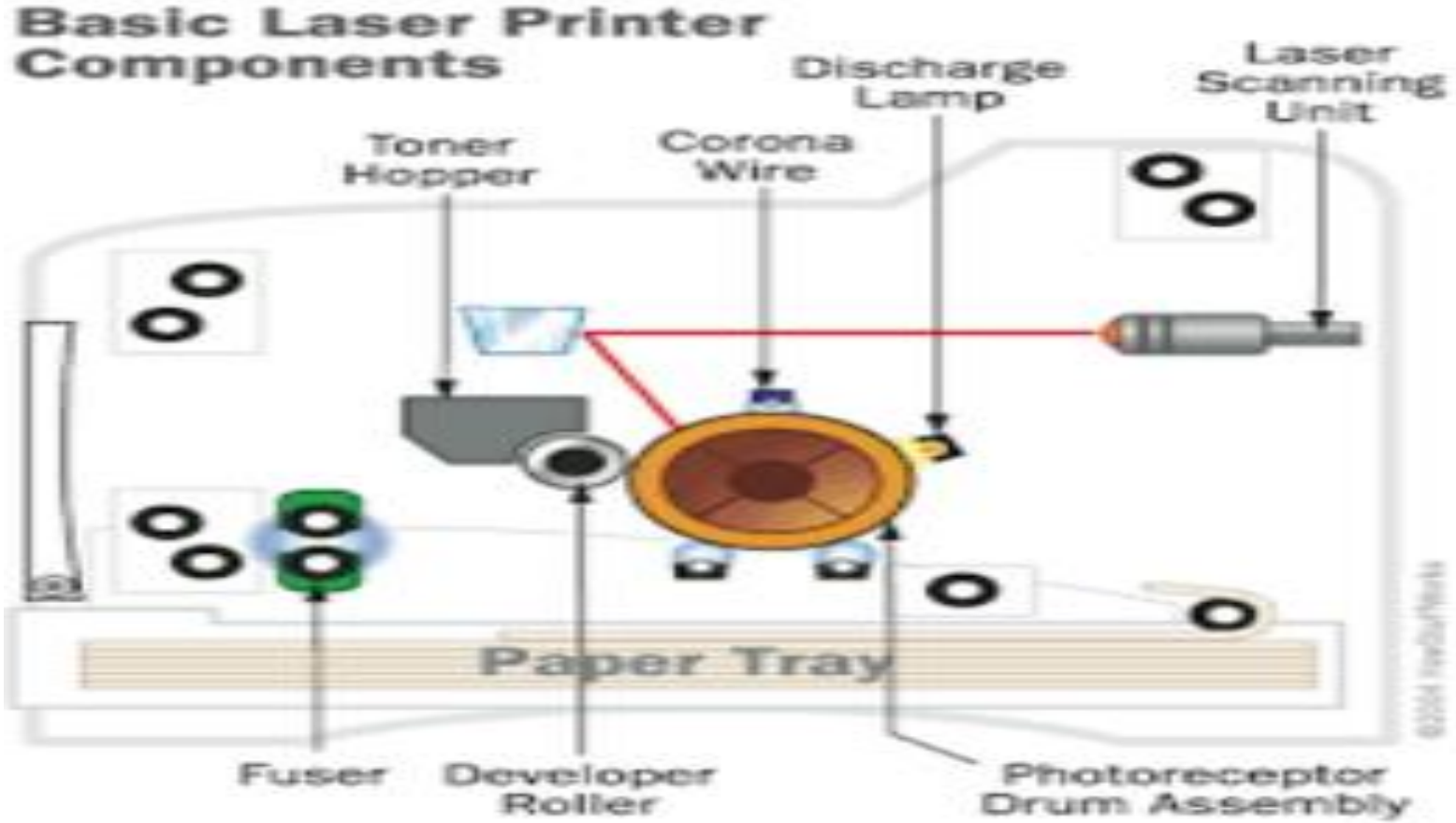
- When you print something, your computer sends a vast stream of electronic data (typically a few megabytes or million characters) to your laser printer.
- An electronic circuit in the printer figures out what all this data means and what it needs to look like on the page.
- It makes a laser beam scan back and forth across a drum inside the printer, building up a pattern of static electricity.
- The static electricity attracts onto the page a kind of powdered ink called toner. Finally, as in a photocopier, a fuser unit bonds the toner to the paper.

- Millions of bytes (characters) of **data** stream into the printer from your computer.
- An **electronic circuit** in the printer (effectively, a small computer in its own right) figures out how to print this data so it looks correct on the page.
- The electronic circuit activates the **corona wire**. This is a high-voltage wire that gives a static electric charge to anything nearby.
- The corona wire charges up the **photoreceptor drum**so the drum gains a positive charge spread uniformly across its surface.

- At the same time, the circuit activates the **laser** to make it draw the image of the page onto the drum.
- The laser beam doesn't actually move: it bounces off a moving mirror that scans it over the drum. Where the laser beam hits the drum, it erases the positive charge that was there and creates an area of negative charge instead.
- Gradually, an image of the entire page builds up on the drum: where the page should be white, there are areas with a positive charge; where the page should be black, there are areas of negative charge.

- An **ink roller** touching the photoreceptor drum coats it with tiny particles of powdered ink (toner).
- The toner has been given a positive electrical charge, so it sticks to the parts of the photoreceptor drum that have a negative charge (remember that opposite electrical charges attract in the same way that opposite poles of a magnet attract).
- No ink is attracted to the parts of the drum that have a positive charge. An inked image of the page builds up on the drum.

- A sheet of **paper** from a hopper on the other side of the printer feeds up toward the drum. As it moves along, the paper is given a strong positive electrical charge by another corona wire.
- When the paper moves near the drum, its positive charge attracts the negatively charged toner particles away from the drum. The image is transferred from the drum onto the paper but, for the moment, the toner particles are just resting lightly on the paper's surface.
- The inked paper passes through two hot rollers (the **fuser unit**). The heat and pressure from the rollers fuse the toner particles permanently into the fibers of the paper.
- The **printout** emerges from the side of the copier. Thanks to the fuser unit, the paper is still warm. It's literally hot off the press


Basic Laser Printer Components
Discharge Lamp
Laser Scanning Unit
Toner Hopper
Corona Wire
Paper Tray
Fuser
Developer Roller
Photoreceptor Drum Assembly

- Plotter

- Pen plotters print by moving a pen or other instrument across the surface of a piece of paper. This means that plotters are vector graphicsdevices, rather than raster graphics as with other printers.
- Pen plotters can draw complex line art, including text, but do so slowly because of the mechanical movement of the pens. They are often incapable of efficiently creating a solid region of color, but can hatch an area by drawing a number of close, regular lines.
- Plotters offered the fastest way to efficiently produce very large drawings or color high-resolution vector-based artwork when computer memory was very expensive and processor power was very limited, and other types of printers had limited graphic output capabilities

- Pen plotters have essentially become obsolete, and have been replaced by large-format inkjet printers and LED toner based printers.

- Electrostatic plotters used a toner transfer process similar to that in many photocopiers. They were faster than pen plotters and were available in large formats, suitable for reproducing engineering drawings. The quality of image was often not as good as contemporary pen plotters. Electrostatic plotters were made in both flat-bed and drum types
- Cutting plotters use knives to cut into a piece of material (such as paper, mylar or vinyl) that is lying on the flat surface area of the plotter. It is achieved because the cutting plotter is connected to a computer, which is equipped with specialized cutting design or drawing computer software programs

- **Drum Plotter**
- A drum plotter is also known as Roller Plotter. It consists of a drum or roller on which a paper is placed and the drum rotates back and forth to produce the graph on the paper.
- It also consists of mechanical device known as Robotic Drawing Arm that holds a set of colored ink pens or pencils.
- The Robotic Drawing Arm moves side to side as the paper are rolled back and forth through the roller. In this way, a perfect graph or map is created on the paper. This work is done under the control of computer. Drum Plotters are used to produce continuous output, such as plotting earthquake activity.

- **Flatbed Plotter**
- A flatbed plotter is also known as Table Plotter. It plots on paper that is spread and fixed over a rectangular flatbed table. The flatbed plotter uses two robotic drawing arms, each of which holds a set of colored ink pens or pencils.
- The drawing arms move over the stationary paper and draw the graph on the paper. Typically, the plot size is equal to the area of a bed.
- The plot size may be 20- by-50 feet. It is used in the design of cars, ships, aircrafts, buildings, highways etc. Flatbed plotter is very slow in drawing or printing graphs. The large and complicated drawing can take several hours to print.
- The main reason of the slow printing is due to the movement mechanical devices.


MME 10

Display Devices:

A **display device** is an output device for presentation of information in visual form. When the input information is supplied as an electrical signal, the display is called an *electronic display*. Different Devices are

LCD display

LED Display

Plasma Display

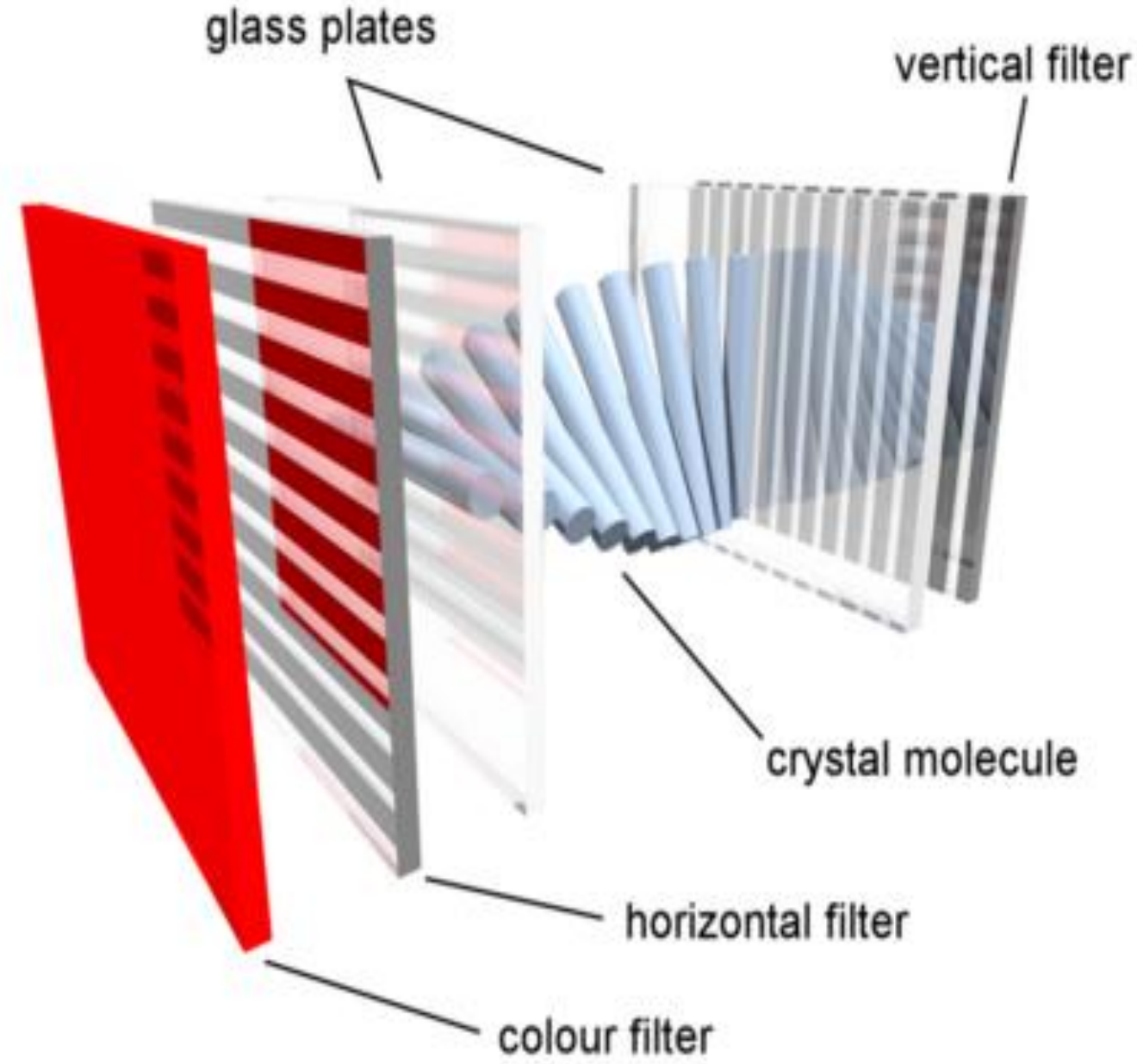
CRT

- **LCD**
- A **liquid-crystal display** (**LCD**) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals.
- Liquid crystals do not emit light directly.
- The LCD screen is more energy efficient and can be disposed of more safely than a CRT. Its low electrical power consumption enables it to be used in battery-powered electronic equipment.

- Each pixel of an LCD typically consists of a layer of molecules aligned between two transparent electrodes, and two polarizing filters (parallel and perpendicular.
- The electrodes provide electric power to the liquid crystal layer, and don't block the light. Light travels with 'polarity' or direction, and a polarizing filter only lets light with one kind of polarity to go through it, like trying to slide a ruler through a narrow opening.
- Without the liquid crystal between the polarizing filters, light passing through the first filter would be blocked by the second (crossed) polarizer.
- The layer of liquid crystals between the two filters can 'twist' the light so that the polarity changes. This means the light can then pass through both filters, and the pixel appears clear. When giving an electric current to the liquid crystals, the molecules will untwist and will not change the light. The filters then block the light and the pixel appears dark

- In color LCD each pixel is dovided into three cells or sub pixels ,whis are colored red,green and blue respectively.
- Each subpixel cam be controlled indipendently to yield thousands or millions of possible colours for each pixel

- Thin Film Transistor(TFT) LCD are currently the most popular display devices for computers.


glass plates
vertical filter
crystal molecule
horizontal filter
colour filter

- Plasma

- A plasma display is a computer video display in which each pixel on the screen is illuminated by a tiny bit of plasma or charged gas, somewhat like a tiny neon light.
- Plasma displays are thinner than cathode ray tube (CRT) displays and brighter than liquid crystal displays (LCD).
- Plasma displays are sometimes marketed as "thin-panel" displays and can be used to display either analog video signals or display modes digital computer input.

- In addition to the advantage of slimness, a plasma display is flat rather than slightly curved as a CRT display is and therefore free of distortion on the edges of the screen.
- Unlike many LCD displays, a plasma display offers a very wide viewing angle.
- Plasma displays come in conventional PC displays sizes and also in sizes up to 60 inches for home theater and high definition television .

- Plasma screens are made of 2 sheets of glass with 2 gases stored between the sheets.
- The gases are xenon and neon and they fill thousands of tiny chambers, or spaces.
- Behind each space are a series of red, blue and green phosphors(substances that give off light when struck by light).
- When electricity connects to the plasma chambers it ionises the gases and exites them.
- Xenon and neon atoms, the atoms used in plasma screens, release light photons when they are excited.,which are invisible to the human eye.

- 1. Larger screen size availability.

  2. Better contrast ratio and ability to render deeper blacks.

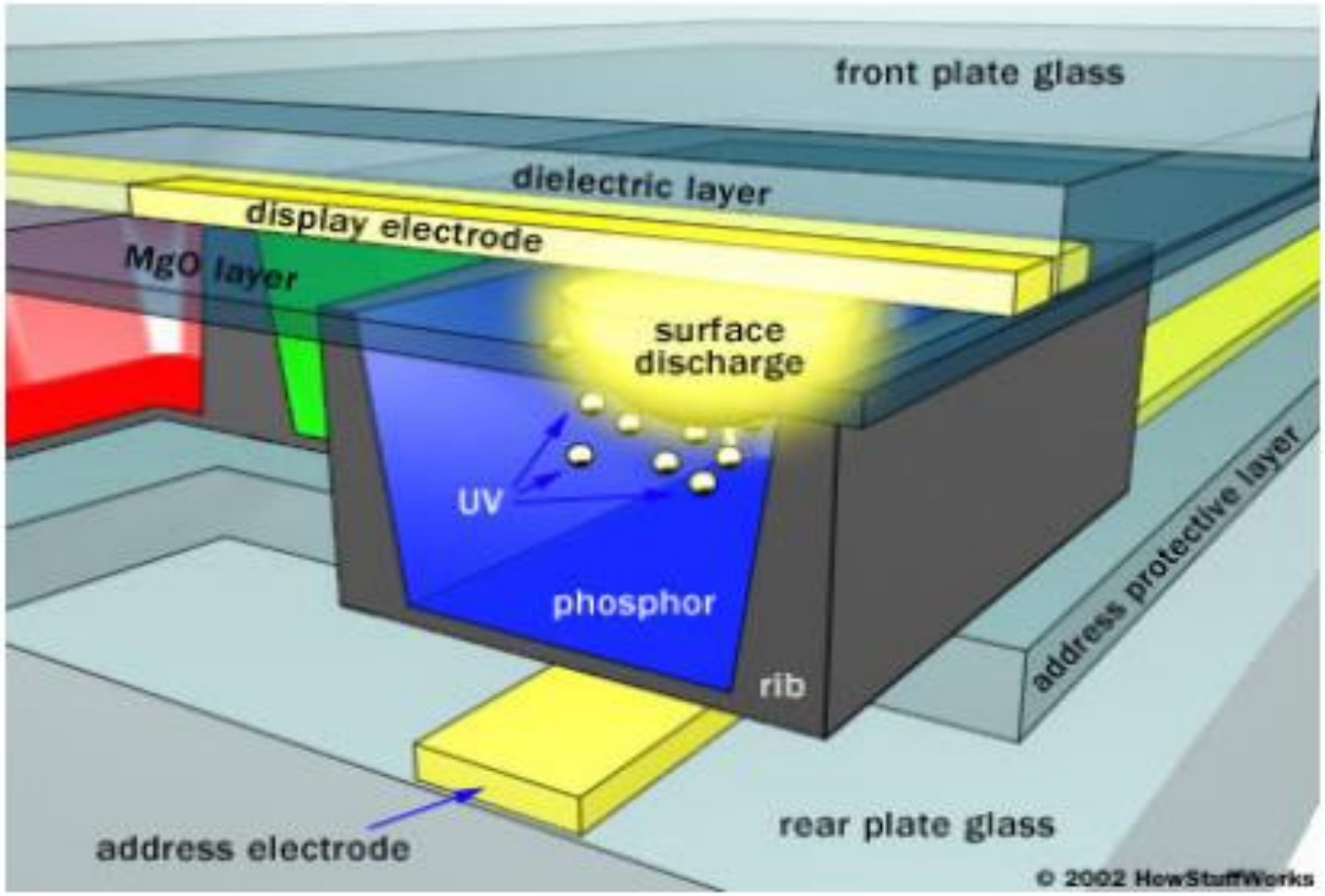
  3. Better color accuracy and saturation.

  4. Better motion tracking (little or no motion lag in fast moving images).

- The Disadvantage of Plasma TVs

. Plasma TVs requires more power thus more heat produced than LCDs.

. Shorter display life span than LCD.


front plate glass
dielectric layer
display electrode
MgO layer
surface discharge
UV
phosphor
rib
address protective layer
address electrode
rear plate glass
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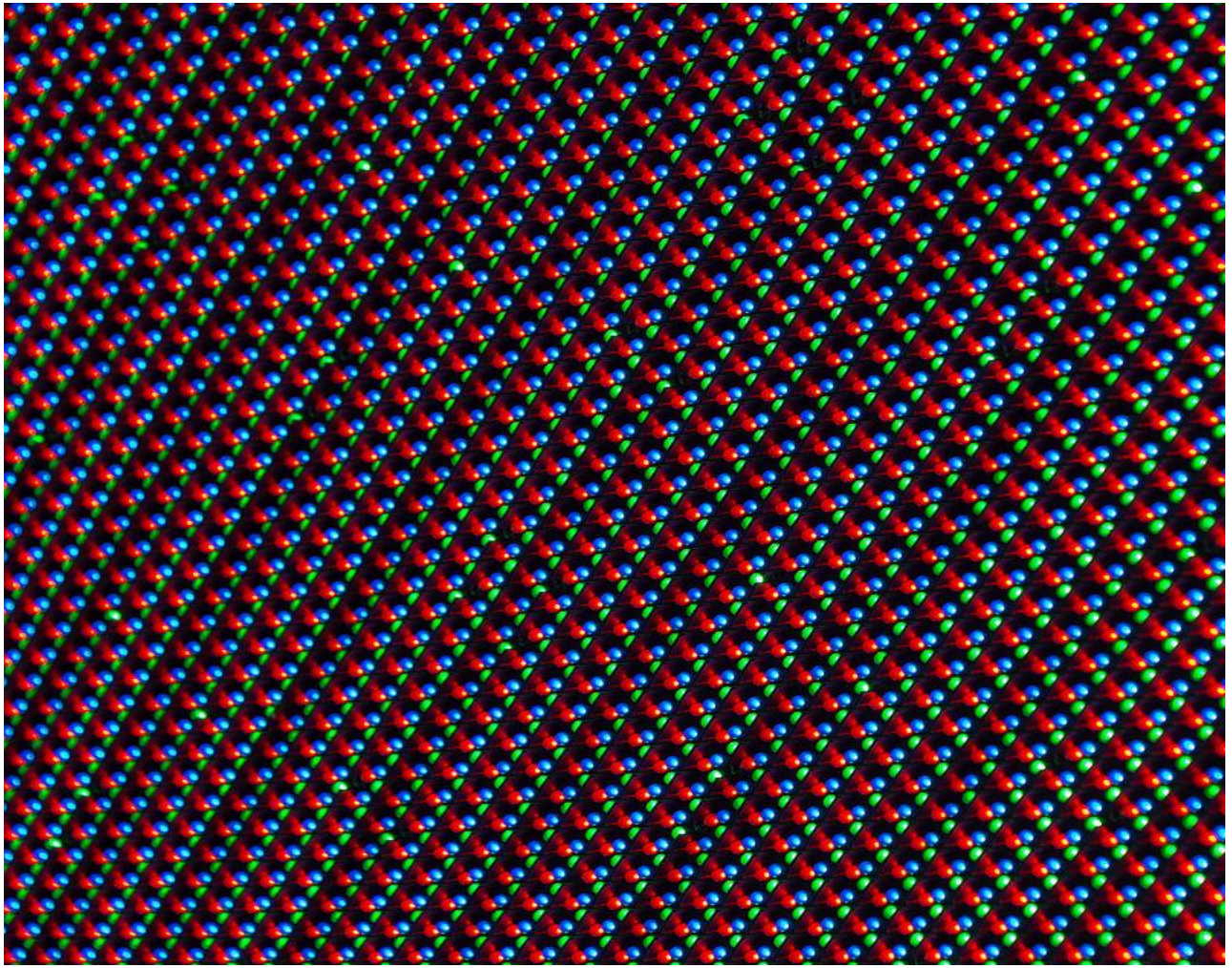
- LED

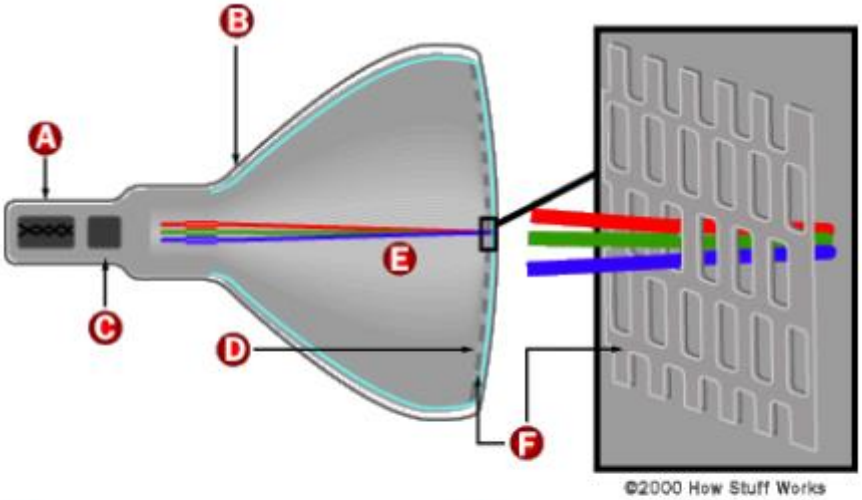
- An **LED display** is a flat panel display, which uses an array of light-emitting diodes as pixels for a video display.



- CRT

- A cathode ray tube is an electron gun. The cathode is an electrode (a metal that can send out electrons when heated).
- The cathode is inside a glass tube. Also inside the glass tube is an anode that attracts electrons. This is used to pull the electrons toward the front of the glass tube, so the electrons shoot out in one direction, like a ray gun. To better control the direction of the electrons, the air is taken out of the tube, making a vacuum.

- The electrons hit the front of the tube, where a phosphor screen is. The electrons make the phosphor light up. The electrons can be aimed by creating a magnetic field.
- By carefully controlling which bits of phosphor light up, a bright picture can be made on the front of the vacuum tube. Changing this picture 30 times every second will make it look like the picture is moving. Because there is a vacuum inside the tube (which has to be strong enough to hold out the air), and the tube must be glass for the phosphor to be visible, the tube must be made of thick glass. For a large television, this vacuum tube can be quite heavy.



A Cathode
B Conductive coating
C Anode
D Phosphor-coated screen
E Electron beams
F Shadow mask