FUNDAMENTALS OF COMPUTER SCIENCE

UNIT-1

COMPUTER:

1. A comp is an electronic device which processes raw data according to the programmed instruction to produce the O/P in useful form.

2. Comp is an electronic device which is capable of solving any problems (simple or complex) by accepting input in the form of data, performing prescribed operation in this data in a specified sequence and finally supplying result (or information) after this operation, in the form of an output.

Characteristics:

1. Automatic: - Computers are automatic machines because once started on job, they carry on, until job is finished.

2. Speed: - It can perform in a few seconds, may be milliseconds (10- 3), microseconds (10- 6), nanoseconds (10-9), picoseconds (10-12) and a powerful computer perform several billion (109) operation in a second.

3. Accuracy: - Large calculations in a few seconds accurately without any interruption, for this reason computer are used in banks, aircrafts, and remote senescing for accurate results.

4. Reliability: - Computers are reliable, unlike humans, computer simply do not get bored or tired.

5. Memory/storage capabilities: - It has large amount of memory which is capable to store large amount of data for time being.

6. Perfectionist: - A computer is diligent it never loses concentration. It can work for hours without committing any mistake and getting irritated. Performed millionth calculation with the same accuracy and speed.

7. Flexibility: - It can switch from one application to another means one moments play a song can be sketch to print out any letter / report or may be another work.

8. Artificial intelligence: - A computer has no I.Q. all intelligence is incorporated in the computer as programs. So, it cannot take decision of its own.

9. Numbness: - computer has no emotions and feeling because they are machines. It can work for hours in extreme weather condition.

10. Diligence

11. Experience less

12. User friendly

Limitation of a computer:

Computer have the major limitation is that it is not intelligent enough to take its own decisions and it can be easily crashed which would result in data or information.

1. Computer cannot take over all activities simply because they are less flexible than human.
2. Computers do not have the potential to try out various alternative to solve the unexpected.
3. It does not have the capability to learn from experience.
4. It has to be given every details instruction and every step of its operation has to be described.
5. They are always a threat to personal privacy.
6. They are manufactured using hazardous chemicals hence harming the health of people working and also contributing in pollutions.
7. Discarded computers are real junk and consume lot of space.
8. They are failure prone. A failure in a nuclear power station or airplane etc. can endanger many lives and resources.
9. Working too much time in computer gives the user back pain, nerve injuries etc.
10. By automating tasks- unemployment is increasing at a very high speed.

The Evolution of computer / generations:

The generation of computers is based on when major technological changes occur within the computer, like the employment of the microprocessor, vacuum tubes, and transistors. The primary generation of this complex system began about 1940, and there are five generations of the computer till 2020.

1. First-generation (1940 - 1956)

The first electronic computer used vacuum tubes as a serious piece of technology that was ENIAC, which stands for Electronic Numeric Integrated and Calculator, invented by J.W.Mauchy and J.P.Eckert. From 1940 through 1956, vacuum tubes were widely employed in computers.

The first-generation computers were very large in size and took up much space in the room because vacuum tubes were larger components used in the computers.

Even some of the first-generation computers were such large in size; they took up an entire room. It weighed more than 30 tons and included 70,000 resistors, 10,000 capacitors, additionally as approximately 20,000 vacuum tubes. The below picture is of the vacuum tubes.

Examples:

- UNIVAC
- IBM-701

- ENIAC
- EDVAC
- IBM-650

Advantages:

1. These computers were in no time in terms of calculating. They might calculate in milliseconds.
2. Vacuum tubes are the electronic components available at that time, which were used by these computers.

Disadvantages:

1. These computers' weight was about 30 tones and took up a lot of space as they were very big in size.
2. These computers were very costly and based on vacuum tubes.
3. Due to the presence of magnetic drums, they were only able to store a small amount of information.
4. As the first generation of computers were used vacuum tubes, which need a large cooling system.
5. They consumed a large amount of energy and had less work efficiency.
6. They needed punch cards to give input and had limited programming capabilities.

2. Second generation (1956 - 1963)

Instead of vacuum tubes, the second generation of computers was supported transistors. From 1956 through 1963, transistors were widely utilized within the second generation of computers.

As compared to the primary generation of computers, these computers were small in size because they used transistors in these generations of computers that were smaller than vacuum tubes. Also, in terms of speed, the second generation of computers was faster. And they were cheaper to create.

In 1956, computer TX-0 was introduced, which was the primary computer that used transistors. Some samples of the second generation of computers are given below:

- CDC 3600
- Honeywell 400
- UNIVAC 1108
- IBM 7094
- CDC 1604, and many more

Advantages:

1. The dimensions of the electron component decreased thanks to the existence of transistors rather than vacuum tubes. Hence, the scale of those computers was small in size as compared to the previous generation of computers.
2. These computers consumed less energy and did not produce the maximum amount of heat because of the first generation of computers.
3. In these computers, punch cards and Assembly language were used to give input.
4. As compared to the first generation, it had better portability and low cost.
5. Furthermore, these computers were faster in speed as could calculate data in microseconds.

Disadvantages:

1. It required a cooling system and constant maintenance.
2. Also, these computers were used only for a particular objective.

Third generation (1964 - 1971)

The third generation of computers was supported Integrated circuits. In 1958-1959, Jack Kilby and Robert Noyce invented the IC (Integrated circuit), which was a signal component that could have a number of transistors. The utilization of Integrated circuits within the computers made them faster and helped reduce the scale of computers as compared to second-generation computers.

In the mid to late 1960s, almost all computers have used Integrated circuits. Although many people considered the time period of the third-generation computer is from 1964 to 1971. Today's computers are still using Integrated circuits. Below, some examples of the third generation of computers are given:

- IBM 370
- PDP-8
- ICL 2900
- IBM 360
- PDP-11, and many more

Advantages:

1. As compared to the second-generation computer, these computers were cheaper in cost.
2. This generation's computers used Integrated circuits that made them small in size. Also, they were reliable and faster in speed.
3. The use of an integrated circuit was not only beneficial for reducing the size of the computer; it also enhances the performance of the computer comparing the second-generation computer.
4. The third generation of computers introduced a big storage capacity.
5. In these computers, keyboard and mouse were used to give the input rather than punch cards.

6. These generation computers were much fast in terms of calculation; they decrease the computational time from microseconds to nanoseconds.
7. Furthermore, for better performance, these computers used operating systems and used multiple programming and the concept of time-sharing.

Disadvantages:

1. Air conditioning was required by these computers.
2. The manufacturing of IC chips required a highly sophisticated technology; also, IC chips are not easy to maintain.

Fourth generation (1972 - 2010)

The Microprocessor, commonly called a CPU (Central Processing Unit), was used by the fourth generation of computers. A microprocessor is used in a computer that led to makes a computer more powerful and small in size as well as fits easily on a desk. Also, microprocessors, along with integrated circuits, helped to introduce the laptop.

For providing users more comfort, GUI (Graphics User Interface) technology was exploited. The IBM 5100, Altair 8800, Micral, and some others are older computers that used a microprocessor.

Although the fourth generation is considered to have ended in 2010, in modern times, the microprocessor is still in use in computers. The below is of the microprocessor. Some examples of the fourth-generation computers are given below:

- STAR 1000
- PUP 11
- IBM 4341
- DEC 10

Advantages:

1. The first advantage of this generation computer is that the size gets reduced and fastest in computation, comparing to the previous generation of computer.
2. Its heat generated is negligible and required less maintenance.
3. In these types of computers, all kinds of high-level language can be used.

Disadvantages:

1. The fabrication and design of the microprocessor are not simple.
2. In many cases, air conditioning is needed due to the occurrence of Integrated circuits.
3. For making the Integrated circuit, advanced technology is required.

Fifth-generation (2010 to present)

The fifth generation of computers is predicated on artificial intelligence. AI is an advanced technology that contains various possible applications all over the world.

The primary purpose of this generation of computers is to make a device more capable of self-organization and learning, including could respond to natural language input.

The ten million electronic components have consisted of the production of a microprocessor as this generation is based on Ultra Large-Scale Integration (ULSI). Although AI made computers more powerful, there is still a need for some improvement in the computer.

Some more examples are:

- UltraBook
- Chromebook
- Desktop
- Laptop
- NoteBook

Advantages:

1. It has unique features and is available in several sizes.
2. It is more reliable and has the ability to work much faster.
3. It offers computers that have a more friendly UI (User Interface), including multimedia features.

Disadvantages:

1. In these computers, very low-level languages are required.
2. They may be harmful in terms of making human brains doomed and dull.

Classification of Computer:

The computer systems can be classified on the following basis:

(A) On the basis of size.
(B) On the basis of functionality.
(C) On the basis of data handling.

(A) On the basis of size:-

1. Super-computers: The super computers are the most high performing system. A supercomputer is a computer with a high level of performance compared to a general-purpose computer. The actual Performance of a supercomputer is measured in FLOPS instead of MIPS.

super computers are used for intensive computation tasks in various fields, including quantum mechanics, weather forecasting, climate research, oil and gas exploration, molecular modeling, and physical simulations.

Example: PARAM, jaguar, roadrunner.

2. Mainframe computers : These are commonly called as big iron, they are usually used by big organizations for bulk data processing such as statics, census data processing, transaction processing and are widely used as the servers as these systems has a higher processing capability.

Example: IBM z Series, System z9 and System z10 servers.

3. Mini computers: These computers came into the market in mid 1960s and were sold at a much cheaper price than the main frames, they were actually designed for control, instrumentation, human interaction, and communication switching as distinct from calculation and record keeping, later they became very popular for personal uses with evolution.

In the 60s to describe the smaller computers that became possible with the use of transistors and core memory technologies, minimal instructions sets and less expensive.

Example: Personal Laptop, PC etc.

4. **Microcomputers:** A microcomputer is a small, relatively inexpensive computer with a microprocessor as its CPU. It includes a microprocessor, memory, and minimal I/O circuitry mounted on a single printed circuit board. The previous to these computers, mainframes and minicomputers, were comparatively much larger, hard to maintain and more expensive.

Example: Tablets, Smartwatches.

(B) On the basis of functionality:-

1. Servers: Servers are nothing but dedicated computers which are set-up to offer some services to the clients. They are named depending on the type of service they offered.

Example: security server, database server.

2. Workstation: Those are the computers designed to primarily to be used by single user at a time. They run multi-user operating systems. They are the ones which we use for our day to day personal / commercial work.

3. Information Appliances: They are the portable devices which are designed to perform a limited set of tasks like basic calculations, playing multimedia, browsing internet etc. They are generally referred as the mobile devices. They have very limited memory and flexibility and generally run on “as-is” basis.

4. Embedded computers: They are the computing devices which are used in other machines to serve limited set of requirements. They follow instructions from the non-volatile memory and they are not required to execute reboot or reset. The processing units used in such device work to those basic requirements only and are different from the ones that are used in personal computers- better known as workstations.

(C) On the basis of data handling:-

1. Analog: An analog computer is a form of computer that uses the continuously-changeable aspects of physical fact such as electrical, mechanical, or hydraulic quantities to model the problem being solved. Anything that is variable with respect to time and continuous can be claimed as analog just like an analog clock measures time by means of the distance traveled for the spokes of the clock around the circular dial.

2. Digital: A computer that performs calculations and logical operations with quantities represented as digits, usually in the binary number system of "0" and "1", "Computer capable of solving problems by processing information expressed in discrete form. from manipulation of the combinations of the binary digits, it can perform mathematical calculations, organize and analyze data, control industrial and other processes, and simulate dynamic systems such as global weather patterns.

3. Hybrid: A computer that processes both analog and digital data, Hybrid computer is a digital computer that accepts analog signals, converts them to digital and processes them in digital form.

Application of Computer: -

- Home
- Medical field
- Entertainment
- Arts
- Industry
- Education
- Banking
- Business
- Government sectors
- Science & Engineering etc.

INPUT DEVICES:

1. Keyboard:

- A keyboard is one of the primary input devices that allows users to input text into a computer or any other electronic machinery.
- It is a peripheral device that is the most basic way for the user to communicate with a computer.
- It consists of multiple buttons, which create numbers, symbols, and letters, and special keys like the Windows and Alt key, including performing other functions.

Types of keyboards:

1. Flexible keyboard: It is a type of keyboard that is made of soft silicone with highly portable. It is water and dust-resistant and does not require constant cleaning.

It acts the same as a standard keyboard and connects to the computer via a USB connection serial port. These types of keyboards can also be more durable in terms of some ways, as compared to a traditional keyboard.

2. Ergonomic Keyboard: This type of keyboard is beneficial for your body posture. Instead of adjusting yourself to fit the keyboard, it is designed to fit you easily, ease of use, and reduce strain.

It is designed in that way; instead of bending their hands, it allows users to straight their hands. Generally, the space-bar is bigger as compared to a regular keyboard, which allows for fast typing.

3. Wireless Keyboard: It is a computer keyboard that is connected to computers, laptops, or tablets without any cables. It uses radio frequency (RF), infrared (IR), or Bluetooth technology to connect with devices. Users can move the wireless keyboard around without having to put it on a desk as it provides portability and flexibility to the users.

It is designed by stainless steel material that increases its life for a long time. It can set up very easily by plugging the USB receiver into the computer.

4. Mechanical Keyboard: It is made with high quality that commonly used in both home and office. It is designed for long life with high durability and responsiveness. It provides crisp click sound, medium resistance, and better feedback for gaming performance and ultimate typing.

It offers framing, switches, type print methods, functionality, PCB board, key construction, LED lighting, or more other better features as compared to traditional rubber dome keyboards.

5. Virtual Keyboard: It is a software-based keyboard that enables users to type without the need for physical keys. It is an alternative for a physical keyboard or a digital representation of a QWERTY keyboard. These types of keyboards commonly have many pages of characters, including numbers, letters, punctuation, and symbols. Some virtual

keyboards also include options to insert emojis, stickers, or animated GIFs on the basis of the device's operating system. The devices that contained virtual keyboard are tablets, smartphones, and other portable devices, because these devices do not require the constant use of a physical keyboard.

2. Pointing Devices:

A. Mouse:

- The mouse is a hand-held input device which is used to move cursor or pointer across the screen. It is designed to be used on a flat surface and generally has left and right button and a scroll wheel between them.
- It lets you control the movement of cursor or pointer by moving your finger over the touchpad. Some mouse comes with integrated features such as extra buttons to perform different buttons.

- The mouse was invented by Douglas C. Engelbart in 1963. Early mouse had a roller ball integrated as a movement sensor underneath the device.
- Modern mouse devices come with optical technology that controls cursor movements by a visible or invisible light beam. A mouse is connected to a computer through different ports depending on the type of computer and type of a mouse.

types of the mouse:

1. Trackball Mouse:

- It is a stationary input device that has ball mechanism to move the pointer or cursor on the screen.
- The ball is half inserted in the device and can be easily rolled with finger, thumb or the palm to move the pointer on the screen. The device has sensor to detect the rotation of ball.
- It remains stationary; you don't need to move it on the operating surface. So, it is an ideal device if you have limited desk space as you don't need to move it like a mouse.

2. Mechanical Mouse:

It has a system of a ball and several rollers to track its movement. It is a corded type of mouse. A mechanical mouse can be used for high performance. The drawback is that they tend to get dust into the mechanics and thus require regular cleaning.

3. Optical Mouse:

An optical mouse uses optical electronics to track its movement. It is more reliable than a mechanical mouse and also requires less maintenance. However, its performance is affected by the surface on which it is operated. Plain non-glossy mouse mat should be used for best results.

4. Cordless or Wireless Mouse:

As the name suggests, this type of mouse lacks cable and uses wireless technology such as IrDA or radio to control the movement of the cursor. It is used to improve the experience of using a mouse. It uses batteries for its power supply.

B. Scanner:

The scanner uses the pictures and pages of text as input. It scans the picture or a document. The scanned picture or document then converted into a digital format or file and is displayed on the screen as an output. It uses optical character recognition techniques to convert images into digital ones.

Types of Scanners:

1. Flatbed Scanner:

It has a glass pane and a moving optical CIS or CCD array. The light illuminates the pane, and then the image is placed on the glass pane. The light moves across the glass pane and scans the document and thus produces its digital copy. You will need a transparency adapter while scanning transparent slides.

2. Handheld Scanner:

It is a small manual scanning device which is held by hand and is rolled over a flat image that is to be scanned. The drawback in using this device is that the hand should be steady while scanning; otherwise, it may distort the image. One of the commonly used handheld scanners is the barcode scanner which you would have seen in shopping stores.

3. Sheetfed Scanner:

In this scanner, the document is inserted into the slot provided in the scanner. The main components of this scanner include the sheet-feeder, scanning module, and calibration sheet. The light does not move in this scanner. Instead, the document moves through the scanner. It is suitable for scanning single page documents, not for thick objects like books, magazines, etc.

4. Drum Scanner:

Drum scanner has a photomultiplier tube (PMT) to scan images. It does not have a charge-coupled device like a flatbed scanner. The photomultiplier tube is extremely sensitive to light. The image is placed on a glass tube, and the light moves across the image, which produces a reflection of the image which is captured by the PMT and processed. These scanners have high resolution and are suitable for detailed scans.

5. Photo Scanner:

It is designed to scan photographs. It has high resolution and color depth, which are required for scanning photographs. Some photo scanners come with in-built software for cleaning and restoring old photographs.

C. Joystick:

- The first joystick was invented by C. B. Mirick at the U.S. Naval Research Laboratory. A joystick can be of different types such as displacement joysticks, finger-operated joysticks, hand operated, isometric joystick, and more.
- A joystick is also a pointing input device like a mouse. It is made up of a stick with a spherical base. The base is fitted in a socket that allows free movement of the stick. The movement of stick controls the cursor or pointer on the screen.
- In joystick, the cursor keeps moving in the direction of the joystick unless it is upright, whereas, in mouse, the cursor moves only when the mouse moves.

D. Light Pen:

- first light pen was invented around 1955 as a part of the Whirlwind project at the Massachusetts Institute of Technology (MIT).
- A light pen is a computer input device that looks like a pen. The tip of the light pen contains a light-sensitive detector that enables the user to point to or select objects on the display screen.
- Its light sensitive tip detects the object location and sends the corresponding signals to the CPU. It is not compatible with LCD screens, so it is not in use today. It also helps you draw on the screen if needed.

E. Optical Character Reader (OCR):

OCR computer input device is designed to convert the scanned images of handwritten, typed or printed text into digital text. It is widely used in offices and libraries to convert documents and books into electronic files.

It processes and copies the physical form of a document using a scanner. After copying the documents, the OCR software converts the documents into a two-color (black and white), version called bitmap. Then it is analyzed for light and dark areas, where the dark areas are selected as characters, and the light area is identified as background. It is widely used to convert hard copy legal or historic documents into PDFs. The converted documents can be edited if required like we edit documents created in MS word.

F. Magnetic Ink Character Recognition (MICR):

- MICR computer input device is designed to read the text printed with magnetic ink. MICR is a character recognition technology that makes use of special magnetized ink which is sensitive to magnetic fields.
- It is widely used in banks to process the cheques and other organizations where security is a major concern. The details on the bottom of the cheque (MICR No.) are written with magnetic ink. A laser printer with MICR toner can be used to print the magnetic ink.
- The device reads the details and sends to a computer for processing. A document printed in magnetic ink is required to pass through a machine which magnetizes the ink, and the magnetic information is then translated into characters.

G. Digital camera:

It is a digital device as it captures images and records videos digitally and then stores them on a memory card. It is provided with an image sensor chip to capture images, as opposed to film used by traditional cameras. Besides this, a camera that is connected to your computer can also be called a digital camera.

It has photosensors to record light that enters the camera through the lens. When the light strikes the photosensors, each of the sensors returns the electrical current, which is used to create the images.

3. Speech Recognition:

Speech recognition, or speech-to-text, is the ability of a machine or program to identify words spoken aloud and convert them into readable text. Rudimentary speech recognition software has a limited vocabulary and may only identify words and phrases when spoken clearly. More sophisticated software can handle natural speech, different accents and various languages.

Speech recognition uses a broad array of research in computer science, linguistics and computer engineering. Many modern devices and text-focused programs have speech recognition functions in them to allow for easier or hands-free use of a device.

4. Optical Scanner:

An optical scanner is an input device using light beams to scan and digitally convert images, codes, text or objects as two-dimensional (2D) digital files and sends them to computers and fax machines. Flatbed scanning devices are the most popular optical scanners.

Optical scanners are used for many purposes, including reading customized response forms, creating automated data fields and recording fingerprints.

Willard Boyle and George Smith developed the optical scanner technology in 1969.

Output Devices:

The output device displays the result of the processing of raw data that is entered in the computer through an input device. There are a number of output devices that display output in different ways such as text, images, hard copies, and audio or video.

Classification of Output Devices:

A. Hardcopy output devices
B. Softcopy output devices

A. Hardcopy output devices:

1. Printer:

A printer produces hard copies of the processed data. It enables the user, to print images, text or any other information onto the paper.

Based on the printing mechanism, the printers are of two types: Impact Printers and Non-impact Printers.

A. Impact Printers: These are two types-

1. Character Printers

- Dot Matrix printers
- Daisy Wheel printers

2. Line printers

- Drum printers
- Chain printers

B. Non-impact printers: They are of two types:

1. Laser printers
2. Inkjet printers

A. Impact Printer

The impact printer uses a hammer or print head to print the character or images onto the paper. The hammer or print head strikes or presses an ink ribbon against the paper to print characters and images.

Impact printers are further divided into two types.

1. Character Printers
2. Line printers

1. Character Printers:

Character printer prints a single character at a time or with a single stroke of the print head or hammer. It does not print one line at a time. Dot Matrix printer and Daisy Wheel printer are character printers. Today, these printers are not in much use due to their low speed and because only the text can be printed.

The character printers are of two types, which are as follows:

i. Dot Matrix Printer:

Dot Matrix Printer is an impact printer. The characters and images printed by it are the patterns of dots. These patterns are produced by striking the ink-soaked ribbon against the paper with a print head. The print head contains pins that produce a pattern of dots on the paper to form the individual characters.

The print head of a 24-pin dot matrix contains more pins than a 9-pin dot matrix printer, so it produces more dots which results in better printing of characters. To produce color output, the black ribbon can be changed with color stripes. The speed of Dot Matrix printers is around 200-500 characters per second.

ii. Daisy Wheel Printer:

Daisy Wheel Printer was invented by David S. Lee at Diablo Data Systems. It consists of a wheel or disk that has spokes or extensions and looks like a daisy, so it is named Daisy Wheel printer.

At the end of extensions, molded metal characters are mounted. To print a character the printer rotates the wheel, and when the desired character is on the print location the hammer hits disk and the extension hits the ink ribbon against the paper to create the impression.

It cannot be used to print graphics and is often noisy and slow, i.e., the speed is very low around 25-50 characters per second. Due to these drawbacks, these printers have become obsolete.

2. Line Printers:

Line printer, which is also as a bar printer, prints one line at a time. It is a high-speed impact printer as it can print 500 to 3000 lines per minute. Drum printer and chain printer are examples of line printers.

i. Drum Printer:

Drum printer is a line printer that is made of a rotating drum to print characters. The drum has circular bands of characters on its surface. It has a separate hammer for each band of characters. When you print, the drum rotates, and when the desired character comes under the hammer, the hammer strikes the ink ribbon against the paper to print characters. The drum rotates at a very high speed and characters are printed by activating the appropriate hammers. Although all the characters are not printed at a time, they are printed at a very high speed. Furthermore, it can print only a predefined style as it has a specific set of characters. These printers are known to be very noisy due to the use of hammering techniques.

ii. Chain Printer:

Chain printer is a line printer that uses a rotating chain to print characters. The characters are embossed on the surface of the chain. The chain rotates horizontally around a set of hammers, for each print location one hammer is provided, i.e., the total number of hammers is equal to the total number of print positions.

The chain rotates at a very high speed and when the desired character comes at the print location, the corresponding hammer strikes the page against the ribbon and character on the chain. They can type 500 to 3000 lines per minute. They are also noisy due to the hammering action.

B. Non-Impact Printer:

Non-impact printers don't print characters or images by striking a print head or hammer on the ink ribbon placed against the paper. They print characters and images without direct physical contact between the paper and the printing machinery. These printers can print a complete page at a time, so they are also known as page printers.

The common types of non-impact printers are Laser printer and Inkjet printer:

1. Laser Printer:

A laser printer is a non-impact printer that uses a laser beam to print the characters. The laser beam hits the drum, which is a photoreceptor and draws the image on the drum by altering electrical charges on the drum. The drum then rolls in toner, and the charged image on the drum picks the toner. The toner is then printed on the paper using heat and pressure.

Once the document is printed, the drum loses the electric charge, and the remaining toner is collected. The laser printers use powdered toner for printing instead of liquid ink and produce quality print objects with a resolution of 600 dots per inch (dpi) or more.

2. Inkjet Printer:

The inkjet printer is a non-impact printer that prints images and characters by spraying fine, ionized drops of ink. The print head has tiny nozzles to spray the ink. The printer head moves back and forth and sprays ionized drops of ink on the paper, which is fed through the printer. These drops pass through an electric field that guides the ink onto the paper to print correct images and characters.

An inkjet printer has cartridges that contain ink. Modern inkjet printers are color printers that have four cartridges containing different colors: Cyan, Magenta, Yellow, and Black. It is capable of printing high-quality images with different colors. It can produce print objects with a resolution of at least 300 dots per inch (dpi).

2. Plotter:

A plotter is a type of printer that prints vector graphics. It is a piece of computer gear that converts computer commands into paper line drawings. It draws a line with one or more automatic pens. Unlike a traditional printer, a plotter uses a pen, marker, pencil, or other writing tools to draw multiple rather than toner. It may also use vector graphics files or commands to draw continuous point-to-point lines.

Though it was previously widely used for computer-aided design, it is now only used to print hard copies of schematics and other comparable application.

Applications of Plotters:

- Draw charts
- Computer-aided designs
- Architectural Blueprints
- Textile Printing
- Banners and Billboards
- Electric circuit layouts
- Geographical layouts
- Building plans
- Line Art

Types of Plotters:

There are various types of a plotter, which are as follows:

1. Drum Plotters:

Different sorts of printer designs that draw on paper that is wound around a drum are referred to as "drum printers." The plot is produced in one direction by the drum, while the other is produced by the pens moving in the opposite way. Because it included printed characters carved on a physical drum and impacted paper in certain ways, the previous iteration of the printer is today referred to as a drum plotter.

The drum plotter utilizes a drum to move the paper left and right while one or more pens write up and down, according to the Chron website. The plotter's ability to draw in numerous colors is enhanced by the use of multiple pens.

2. Flatbed plotters:

A flatbed plotter works with paper that is put on a flat surface in a stationary position. In this plotter, the writing pen moves in both the x and y axes. Flatbed plotter pens are available in a number of sizes and colors. Unlike a drum plotter, it works by moving a pen over paper rather than a paper beneath the arm. The paper's size is governed by the size of the flat surface on which it is placed. Larger flatbed plotters have the ability to print up to 60-inches in length on the paper.

In addition to printing on paper, some flatbed plotters are able to print on other materials such as plastic, cardboard, or even metal. Flatbed plotters can make exact copies again and over again without sacrificing the quality of the printed drawing. However, they can be rather expensive to buy and fairly huge in size.

3. Cutting Plotter:

The cutting plotter is a large-scale cutting machine that uses blades instead of pens to cut the design. It creates mylar or vinyl lettering and graphics that are pre-cut. The plotter's flat surface

is used to place the to-be-cut paper. The plotter receives a command from the computer, and the knife executes it to cut the media to the appropriate dimensions.

4. Inkjet Plotter:

The inkjet plotter, as the name implies, sprays microscopic droplets of ink onto paper to form an image, text, or pattern. Inkjet plotters are a popular choice for graphic designers and advertising agencies; they are commonly used for a large printer, like billboards, banners, and big signs that are used for roadside indication.

Thermal and piezo-electric are both technologies that are used by inkjet plotters. Ink droplets are applied using heat in thermal inkjet plotters, whereas charged crystals are used in piezoelectric plotters. On average, inkjet printers generate higher-quality graphics than other plotters.

5. Electrostatic Plotters:

In electrostatic plotters, the images are produced on paper by using raster graphics rather than vector graphics. By using toner ink, dot matrix pixels are generated on the paper. The high voltage charges are created on the paper by the plotter, and these charges hit the toner ink for drawing computer-aided designs. The electrostatic plotters are much faster and economical in price, but they produce lower quality than pen-plotters.

3. Computer Output Microfilm (COM):

Computer Output Microfilm is the course progression, which relocates data stored on the system of computers from electronic media to microfilms. It helps in scaling down the reproduction of papers, made with the objective of broadcast, storage, reading, and printing by large organizations. The top seller of Computer Output Microfilm machines was Anacomp, Inc., San Diego, CA, which offered and facilitated service and restored entities.

The Systems which are used to set up images based on microfilm in punched cards have been extensively used for archival storage of informational data related to engineering.

B. Softcopy output devices:

1. Monitor:

The monitor is the display unit or screen of the computer. It is the main output device that displays the processed data or information as text, images, audio or video.

The types of monitors are given below.

A. CRT Monitor:

CRT monitors are based on the cathode ray tubes. They are like vacuum tubes which produce images in the form of video signals. Cathode rays tube produces a beam of electrons through electron guns that strike on the inner phosphorescent surface of the screen to produce images on the screen.

The monitor contains millions of phosphorus dots of red, green and blue color. These dots start to glow when struck by electron beams and this phenomenon is called cathodoluminescence.

The main components of a CRT monitor include the electron gun assembly, deflection plate assembly, fluorescent screen, glass envelope, and base.The front (outer surface) of the screen onto which images are produced is called the face plate. It is made up of fiber optics.

B. LCD Monitor:

The LCD monitor is a flat panel screen that is compact and light-weight as compared to CRT monitors. It is based on liquid crystal display technology which is used in the screens of laptops, tablets, smart phones, etc. An LCD screen comprises two layers of polarized glass with a liquid crystal solution between them.

When the light passes through the first layer, an electric current aligns the liquids crystals. The aligned liquid crystals allow a varying level of light to pass through the second layer to create images on the screen.

The LCD screen has a matrix of pixels that display the image on the screen. Old LCDs had passive-matrix screens in which individual pixels are controlled by sending a charge.

Modern LCDs use active-matrix technology and contain thin film transistors (TFTs) with capacitors. This technology allows pixels to retain their charge. So, they don't make screen blurry when images move fast on the screen as well as are more efficient than passive-matrix displays.

C. LED monitor:

The LED monitor is an improved version of an LCD monitor. It also has a flat panel display and uses liquid crystal display technology like the LCD monitors. The difference between them lies in the source of light to backlight the display.

The LED monitor has many LED panels, and each panel has several LEDsto backlight the display, whereas the LCD monitors use cold cathode fluorescent light to backlight the display.

Modern electronic devices such as mobile phones, LED TVs, laptop and computer screens, etc., use a LED display as it not only produces more brilliance and greater light intensity but also consumes less power.

D. Plasma Monitor:

The plasma monitor is also a flat panel display that is based on plasma display technology. It has small tiny cells between two glass panels. These cells contain mixtures of noble gases and a small amount of mercury.

When voltage is applied, the gas in the cells turns into a plasma and emits ultraviolet light that creates images on the screen, i.e., the screen is illuminated by a tiny bit of plasma, a charged gas. Plasma displays are brighter than liquid crystal displays (LCD) and also offer a wide viewing angle than an LCD.

Plasma monitors provide high resolutions of up to 1920 X 1080, excellent contrast ratios, wide viewing angle, a high refresh rate and more. Thus, they offer a unique viewing experience while watching action movies, sports games, and more.

2. Projector:

A projector is an output device that enables the user to project the output onto a large surface such as a big screen or wall. It can be connected to a computer and similar devices to project their output onto a screen. It uses light and lenses to produce magnified texts, images, and videos. So, it is an ideal output device to give presentations or to teach a large number of people.

Modern projects (digital projectors) come with multiple input sources such as HDMI ports for newer equipment and VGA ports that support older devices. Some projectors are designed to support Wi-Fi and Bluetooth as well. They can be fixed onto the ceiling, placed on a stand, and more and are frequently used for classroom teaching, giving presentations, home cinemas, etc.

A digital projector can be of two types:

A. Liquid Crystal Display (LCD) digital projector:

This type of digital projectors is very popular as they are lightweight and provide crisp output. An LCD projector uses transmissive technology to produce output. It allows the light source, which is a standard lamp, to pass through the three colored liquid crystal

light panels. Some colors pass through the panels and some are blocked by the panels and thus images are on the screen.

B. Digital Light Processing (DLP) digital projector:

It has a set of tiny mirrors, a separate mirror for each pixel of the image and thus provide high-quality images. These projectors are mostly used in theatres as they fulfill the requirement of high-quality video output.

3. Terminals:

A computer terminal is an electronic or electromechanical hardware device that can be used for entering data into, and transcribing data from, a computer or a computing system.

The teletype was an example of an early-day hard-copy terminal and predated the use of a computer screen by decades.

Types of terminals:

A. Dumb Terminal:

A dumb terminal (or nonprogrammable terminal) cannot do any processing on its own. This means the terminal itself cannot run programs but has another computer do its processing while it displays the results. This type of terminal is common in multiuser or networked systems.

B. Smart Terminal:

A smart terminal (or programmable terminal) does some processing on its own and sometimes has a device (a disk drive, for example) for reading and writing files. This type of terminal is also common in multiuser or networked systems.

C. Graphics Terminal:

A graphics terminal is a smart terminal with special hardware that allows it to display pictures. If you work in a windows interface, you need a special type of graphics terminal known as an X terminal.

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