Input- Output Devices

Input and output devices are used to connect the external world to the computer system

Input-Output devices are of two types:

1. **Hard-Copy devices and**
2. **Non-Hard-Copy devices.**

Hard-copy devices provide the output on paper or other permanent form and obtain the input by reading it from punched cards or by optically or magnetically sensing special printed information.

Non-Hard-Copy devices present the output directly to the user in a non-permanent form, such as the screen of a terminal, or input the information directly to the users a result of some action of the user, such as the pressing of a key on the terminal keyboard.

Keyboard

The keyboard is the most conventional of all input devices. The keyboard detects the key pressed and generates corresponding ASCII code which can recognize by the computer. The prices of keyboards are reasonable and it is very simple to operate. The arrangement of keys is similar to that of the conventional typewriter, but it has additional keys. The computer keyboard has three categories of keys.

1. **Alphanumeric keys.**
2. **Special keys.**
3. **Function keys.**

The alphanumeric keys consists of alphabets and numbers and other special keys which represent certain symbols such as ,.></?:;”’~!@#$%^&*()_+-={}[]|\.

The special keys perform specific tasks. Some of the special keys on the keyboard are. Enter or return key, Tab key, Alt key, Ctrl key, Del key, Ins key, Shift key, Num lock key, Caps lock key and so on.

The function keys are used to perform a set of operation by a single keystroke. The function keys can be used for various functions and depend on the application in use. They usually represent shorthand for a sequence of operations. Based on the number of function keys keyboards are classified as either regular keyboard with 84 keys or Enhanced keyboards with 101 keys and multimedia key boards.

Type’s key board

Standard keyboard: Have their basic layout. The average number of keys on a regular keyboard 105/108, though range of 95-108 slight variations, especially in the manner the keys are placed. QWERTY keyboards are the most common and have the six alphabets Q, W, E, R, T, and Y in the first row.

Ergonomics refers to the study of methods that can reduce stress on muscles to avoid repetitive strain injury. It mostly deals with optimizing posture and technique while working, so the work cab be carried out in the easiest manner with the least possible strain on any muscle joint or organ. Ergonomic keyboards are designed in such a way that typing can be done putting the least amount of stress on fingers and wrist. This is a radical type of keyboard designed to prevent Carpal Tunnel Syndrome.

Wireless Keyboard is a keyboard that does not need to be connected to the computer via a wire this makes it very convenient for the user to use the keyboard comfortably. Wireless keyboard Bluetooth, Infrared (IR), and Radio Frequency to connect to the computer with the help of batteries transmitted and receiver with the range 1 to 40 feet distance contact between the computer and keyboard type very ineffective.

Virtual keyboards are software devices that let you input data just like a hardware keyboard. Open up as an application and can be controlled by a mouse or via a touch screen. They are mainly in devices which do not necessarily require a keyboard, like a tablet or a smart-phone. They are useful they aid in making the size of the device smaller. Virtual keyboards are also used in situations concerning security, as anything entered on an ordinary keyboard is recorded in a key log, leading to security risks associated with passwords or PIN numbers. This is the reason many banks provide the facility of a v: keyboard in their online banking operations.

Compact keyboards are slim and usually do not have the numeric keypad that is present on right side of other keyboards. These are typically used in laptops, where sizing issues make it difficult accommodate a standard keyboard. To make up for the small size, these keyboards rely on the use multiple keys to carry out functions that would only use a single key on a standard-sized keyboard. Some models also include a touch-pad that can be used instead of the Mouse. These are not extremely small size, but offer portability during travel and storage. Another benefit of compact keyboards is that they c be used by people with certain disabilities that hinder them from effectively using hand and finger movement

Mouse

Mouse stands for "**Mechanically Operated User Serial Engine**". One of the most popular of specialized input devices for terminals or microcomputers is the mouse. The mouse is used as a pointing device. It is a small device, which was developed at the Stanford research institute. It has two wheels at right angles to each other. Each of these wheels is connected to the shaft encoder. For every incremental rotation of the wheel, the shaft encoder produces an electrical signal. As the device is moved on a flat surface, the movement is coded in the X and Y directions by counting the number of pulses received from the shaft encoder. These values are held in separate registers and the computer can sample them at a suitable rate. The device can therefore be used for moving a cursor around the display screen.

There are 3 types of Mouse:-

1. **Mechanical**
2. **Optomechanical**
3. **Optical**

1. **Mechanical**:- This mouse has a small hard rubber ball underneath that moves against two roller as it passes across a flat surface. Mechanical sensors detect the movement of the rollers as an 'X' and 'Y' axis and the cursor on screen is moved accordingly.

2. **Optomechanical**:- This mouse works on the same principle. The rollers have wheels on the end of them with evenly spaced holes. As the wheels spin, a light-sensitive optical device counts the number of holes that pass by and convert those numbers to an 'X' and 'Y' axis.

3**. Optical:** - This mouse more accurate or perfect and has no moving parts. It uses a laser to detect movement and has to be paired with a special mat that has an embedded optical reference grid.

In market we get the mouse of type scroll, optic, USB, wireless

Joystick

A joystick normally contains a lever similar to the gear lever of a car. This lever controls the movement of the pointer and the other display objects on the screen. The device is similar to the tracker ball except that the movement is limited. The potentiometers are mounted in such a manner that they are moved when the joystick is moved in the direction, but not when the joystick is moved at right angles. The main usage of a joystick is to play a variety of computer games; it can even be used as a precision device in CAD work.

Devices Using Optical Media

Direct Data Entry (DDE) refers to entry of data directly into the computers through machine readable source documents. DDE does not require manual transcription of data from original paper documents. DDE devices can scan source documents magnetically or optically to capture data for direct entry into the computer. The following devices are falling under this category.

i. **OMR(Optical Mark Reader)**
ii. **OCR(Optical Character Recognition)**
iii. **MICR(Magnetic Ink Character Recognition)**
iv. **Barcode Reader.**

OMR (Optical Mark Reader)

The main use of these devices is to recognize certain pre-specified types of marks such as marks made by pencil or pen. These types of scanners are normally used in grading objective type tests as the CET conducted by the Pre-University board. In these types of exams the student has to mark the answers to questions on a special-scoring sheet by darkening a square or circular space by a pencil to indicate the correct choice out of various alternatives. The person taking exam makes a pencil marks in the circle which he thinks corresponds to the answer. These answer sheets are then directly fed into the computer with the use of a OMR. The OMR focuses light on the page being scanned and detects the reflection pattern. Space which has been marked with pencil or pen normally reflects light.

OCR (Optical Character Recognition)

The main use of these devices is to recognize alphabetic and numeric character printed on paper. The characters may be typewritten or handwritten. Handwritten recognition requires extra care to ensure that the characters are of a standard size, shape and that the characters are connected with no stylish loops and so on. The OCR may be used to recognize certain standard typewritten fonts, some OCR recognize computer outputs also. The OCR goes through each character in details as if the character is made up of a number of minute points. Once the whole character has been scanned it compares the character with a standard font, which the system has been programmed to recognize. Wherever there is a pattern match the character is considered to be read. Even if there is a slight difference the character is rejected.

OCRs are used in applications such as credit card billing and reading of pin code numbers in large post offices to sort mail geographically, used in banks, insurance companies, airlines and some retail outlets.

Advantages of OCR:-

1. OCR eliminates the human effort of transcription.
2. Paper work explosion can be handled because OCR is economical for a high rate of input.
3. Since documents have only to be typed or handwritten, not very skilled staff is required.

Disadvantages of OCR:-

1. Only certain types of printed or handwritten characters can be read.
2. Printing for OCR must meet high standards, and this is expensive.
3. The reject and/or error rate may exceed user requirements.
4. Slightly damage to the document could cause the reader to reject it or read it incorrectly.

MICR (Magnetic Ink Character Recognition)

The Magnetic Ink Character Recognition (MICR) device is normally used to assist the banking sector in processing the cheques that are issued by the customers every day. Special font has been set for these characters by American Banking Association. A Magnetic Ink Character Reader reads these characters by examining their shapes, using 7 x 10 matrixes.

Advantages of MICR:-

1. Provides automated, reliable source data entry.
2. MICR possesses a very high reading accuracy. Cheques may be smeared, stamped, roughly handled yet they are accurately read.
3. Cheques can be read both by human beings and machines.

Disadvantages of MICR:-

- Not fully automatic, the amount of the cheque must be added manually.

Damaged documents, cheques not encoded with amount etc., have still to be manually processed

Output devices

When a computer has completed its processing activities the information that has been produced has to be output in a format that it is useful for further activities. The output from a computer may be required in a form, which is readily understandable by a human being. It may be then stored for future use or processing.

Display Devices

Display device is an output device that conveys text, graphics, and video information to a user. Information on a display device is sometimes called a softcopy because it exists electronically and displays only for a temporary period. Display devices can be monochrome or cooler. Two main types of display devices are CRT (**Cathode Ray Tube**) monitors and LCD (**Liquid Crystal Display**) monitors, LED (**Light Emitting Diode**) monitor and TFT (**Thin Film Transistor**) monitor. A video card is required to display color on monitor. The quality of a display device depends on its resolution, do pitch, and refresh rate.

Advantages of display devices are:

- The time to display the image is fast.
- Screen displays can include text, graphics, and colors.
- Display devices are usually quiet.
- No paper is wasted for obtaining the output.

Disadvantages of display devices are:

- Information produced on the screen is only temporary, and will be lost when the power of the display device is turned off
- Unsuitable for users with visual problems
- Needs a separate devices to produce the hard copy

i. Monitor or Visual Display Unit

Monitor or **Visual Display Unit** (VDU) are devices used to display both text and graphic images from the computer. In fact, Television sets include monitor screens, though in general, the monitor screens used in computer systems are of a much higher quality. Monitors come in various sizes, commonly starting 14", then 15", as well as 17" and 19". This is the size of the viewable screen measured across the diagonal from corner to corner. The larger the size the more expensive the monitor.

Data can be represented on the screen in two modes- text mode and graphics mode. In the text mode only text or individual characters can be displayed. In the text mode, the VDU screen is divided into specific character positions-usually 80 columns of characters across the width of the screen and 25 lines of characters from top to bottom.

In the graphic mode, the pictures can be shown by constructing an image on the screen using dots. In the graphics mode, the screen is treated as an array **of tiny dots called pixels** (picture element) and anything that appears on the screen is shown using dots. A typical high resolution display has 640 columns of dots and across and 480 rows of dots down the screen.

The types of monitor : a) CRT (Cathode Ray Tube) , b) LCD (Liquid Crystal Display) , c) TFT (Thin Film Transistors) and d) LED (Light Emitting Diode)

ii) Printers

The printer is an output device that **prints text or images on paper** or other media like transparencies. This type of output is known as **hard copy output**.

There are two main classifications of printers. They are impact and non-impact printers.

Impact Printers: In impact printers the print head strikes an inked ribbon located between print head and the paper. Or There will be a physical contact between printing mechanism and paper. These are slow and it prints character at a time. The main example of impact printer is Dot matrix printer, Line printer.

Characteristics:

- There is physical contact with paper and printing mechanism
- We can take multiple copies
- These are very noisy
- Printing speed is slow
- Speed is measured in Character Per Second (CPS)

Dot matrix printer: This printer contains a print head which is a matrix of short pins arranged in rows and columns. On receiving instructions from the computer the pins which are required to form that character comes forward from the matrices, these pins strikes the ink ribbon which is held in between the print head and the paper. When the pin strikes the ribbon, they press ink from ribbon onto the paper. The more pins that a print head contains the higher will be the printer's resolution. The lowest resolution printers have only 9 pins and highest resolution printer have 24 pins. The speed of the printer is measured in characters per second (cps). Printers speed range from 30 to 300 cps.

Characteristics:

a) Print head normally has 9 pins. In high quality dot-matrix has 24 pins

b) Printing speed varies from 30 to 300 Characters per seconds

c) Buffer size varies from 1K to 64 K

Advantages: Cost is less

Line printer: High Speed printer capable of printing entire line at a time. It can print 150 to 3000 Lines per Minute. Using this we can print only one font and is not possible to print graphics. The print quality

is low

Non-impact printers: In these printers, the **print head does not make a contact with a paper**. These are higher speed printers and gives better quality output. The printing speed of non-impact printer is usually expressed in pages per minute. The two main types of non-impact printers are inkjet, thermal and laser printer.

Characteristics:

- Print high quality graphics
- They are quite
- It is not possible to take multiple copies at a time
- Speed is measured by Pages Per Minute (PPM)
- The quality of printout is measured by Dots Per Inch (DPI)
- The printing speed is high
- We can take colour printout also

Inkjet printer: It contains a nozzle through which ink is forced through producing droplets of ink, passed through deflection plates which makes drops as a character. Each drop of ink, after leaving the nozzle at a high frequency is charged as it passes an electrode. The drops are deflected using deflected using another electrode. Print quality is high and speed is slow.

Characteristics

1) High resolution inkjet printer has 50-60 nozzles
2) Resolution of the printer is 300 dots per inch
3) Printing speed varies from 1 Page per minute to 12 PPM
4) The buffer size is varies from 1 MB to 4MB
5) Can print the color image

Advantages: Produce color print

Disadvantages: slow compare to laser printer
maintenance cost is more

Laser printers: These are page printers. A page of text or picture is printed at a time. It utilizes a laser beam. The laser exposed area attracts an ink powder that attaches itself to the laser generated charges on the page. The toner is then permanently fused on the paper with heat. The resolution of printing speed varies from 300 to 1200 dot per inch (DPI).These are fast printers and the speed ranges from 10 to 200 pages per minute. It produces a high quality output.

specifications

a) Resolution of printer varies from 600 to 1200 dpi
b) printing speed varies from 8 to 250 PPM (pages per minute)
c)Ram size is vary from 4MB to 32 MB

Advantage: High speed and high quality output

disadvantage: Maintenance cost is more

Thermal Printer: It produce images by pushing electrically heated pins against special heat sensitive paper. This type of printer is inexpensive and mainly used in fax machines. The quality of print is poor by exposing the content to sunlight for one or two week the content is clears

Plotter: Plotters are special kind of output device. It is like a printer because it produces images on the paper, which are used to print large images, such as construction and engineering, drawings created in CAD system. **Different types of plotters are pen plotter, inkjet plotters, electrostatic plotters and thermal plotters**. Pen plotters are the most commonly used ones. Ink jet plotters are cheaper but they consume ink rapidly and the ink is smearable until dry. Electrostatic plotters are expensive and require regular maintenance. Thermal plotters are fast but require special paper and can print only two hours. In general it is more expensive than printer.

Speakers: Today computer is used for a number of purposes. One of them is to listen to good music. For high quality sound it is necessary for us to attach a good speaker to our computer. Good speakers from trusted manufacturers also ensure that consistent and high quality sound is got from games and multimedia software that we use regularly.

Introduction to memory device

The memory is the most essential part of the computer to store the information. We have to store the data for future use. **The storage capacity is measured in terms of bits** (binary digit) and bytes. 8 bits makes one byte.

Units of Memory:
The smallest unit is bit, which mean either 0 or 1.
1 bit = 0 or 1
1 Byte = 8 bit
1 Nibble = 4 bit
1 Kilo Byte = 1024 Byte= 2^{10}
1 Mega Byte = 1024 KB= 2^{20}
1 Giga Byte = 1024 MB= 2^{30}
1 Terra Byte = 1024 GB= 2^{40}
1 Peta Byte =1024 TB= 2^{50}
1 Exa Byte =1024 PB= 2^{60}
1 Zeta Byte = 1024 EB= 2^{70}
1 Yotta Byte = 1024 ZB= 2^{80}
1 Bronto Byte = 1024 YB= 2^{90}
1 Geop Byte = 1024 BB= 2^{100}

Primary memory
Primary memory is the main memory of the computer. The size of primary memory is smaller because it is very costlier considered to secondary memory. The CPU directly communicates with the primary memory. Therefore CPU works with a very high speed and its speed matches with the main memory. **RAM and ROM are the two types of primary memory.**

RAM (**Random Access Memory**): It is volatile in nature. We can identify the location of the memory by its address. **On the memory we can do the read and write operation**

Types of RAM:

1) EDO RAM (Extended Data Output RAM): It is used to improve the speed of reading data
2) Static RAM (SRAM) : Static RAM retains the stored information as long as power supply is on
3) Dynamic RAM (DRAM) : Dynamic RAM loses its stored information in a very short time even though the power supply is on
4) Double Data Rate Ram (DDR): It is very fast computer memory it will work for both pulse of clock signal. It again categorized in to DDR1, DDR2,DDR3 based on the processing sped
5) Synchronous Dynamic RAM (SDRAM): It will work based on the clock pulse. If the clock signal is given then only it will transfer the data.

Functions of primary memory:

1) When the computer is turned on, the OS will be loaded to the primary memory.

2) Temporarily stores the data input from the keyboard, which is required for processing.

3) Temporarily store a copy of application program that is currently being executed.

4) Temporarily store the result, which is generated from processing until it is transferred to an output device

ROM (Read Only Memory): It is another type of primary memory **which is nonvolatile**, i.e., the information stored in it is not lost even when the power supply goes off. It is used for permanent storage of information. There are 3 types of ROM

PROM- It stands for **Programmable Read Only Memory**. Here the user decides the content of the ROM. The user can store permanent programs using special equipment's but PROM is once programmable.

EPROM- It stands for **Erasable Programmable Read Only Memory**. Exposing PROM to high intensity ultraviolet light for about 20 minutes can erase the stored data in EPROM. The technique of erasing content is not easy and convenient; since all the contents will be erased we cannot select a portion of the content for erasing.

EEPROM-An **Electronically Erasable Programmable Read Only Memory** can be programmed through the use of special electrical pulses. It is possible to integrate the circuit into the computer, so that EEPROM does not have to be removed from its socket for programming.

Note: FSB stands for Front Side Bus, It is 2 way data channel that sends the information of the CPU to the various components of mother board like RAM, PCI slot, BIOS, IDE controller.

The need for secondary storage devices: Primary storage devices storage capacity is smaller. It cannot hold programs, data of very huge capacity. So secondary storage devices are required to store data permanently.

Secondary memory: Using this memory we can store information permanently. This memory use the magnetic media to store the information so it can also called as Auxiliary memory

a) **Hard Disk**: It is a main storage unit of a computer It contain physically composed a series of flat magnetic material coated plates arranged on a spindle and also contain a set of **read write head to read and write the information from and to the disk** on each plate. A disk is logically divided into a concentric circle and is called **track** and is divide into smaller unit is called **sector.** The concentric track of each plate is called **cylinder**. Using this we can store more number of information and its storage capacity is varies from 2GB to 750 GB

We can connect the HDD to the computer by 4 different types

SCSI HDD: These drives for high end users with high speed

IDE HDD: Is seen in today's computer

SATA: Serial Advanced Technology Attachment: Has very large capacity and fast transfer rate

External HDD: required to take backup and connected by USB

b) **Floppy Disk Drive (FDD**): It is used to read and write the floppy. The floppy is made by a circular flexible plastic coated with magnetic material. A disk is logically divided into a concentric circle and is called **track** and is divide into smaller unit is called **sector.** It can be classified into 4 types

Type	Size in inch	Capacity
Single side single density	5.25	360 KB
Single side double density	5.25	1.3 MB
double side single density	3.5	1.44MB
double side double density	3.5	2MB to 2.88MB

c) Optical Disks: It consists of a rotating disk which is coated with a highly reflective material. Data recording on the disk is done by focusing a laser beam on the surface of the spinning disk. The laser beam is turned on and off at varying rates this causes tiny holes to be burnt on the surface. The holes are burnt along the surface of the tracks. In order to read the data a less powerful beam is focused on the surface. The beam is strongly reflected by the normal surface and weakly reflected by the pits. This sequence of reflections is then converted into electronic signals. There are different types of optical laser disks. They are,

CD-ROM: **Compact Disk Read Only Memory** is an optical storage medium capable of holding up to 682 Mb of data or 74 minutes of audio or video data. It is faster than floppy disk but slower than the hard disk. CD drive is needed to read the contents of the disk. They are of two types.

i) **CD-R** which is also called as recordable CD in which the data can be written once and can be read again and again. The stored content cannot be erased.

ii) **CD-RW** which is also called as Rewritable CDs which allows the user to erase recorded information and which allows writing the new information on the same physical location again and again.

DVD (digital Versatile Disk): It is advanced optical disk technology with more storage capacity. It varies from 1.44 GB to 8.7GB. We can store all type of data

Blue ray disk (BD): it looks similar to CD or DVD. Here the information is stored by using UV ray. The wave length of UV ray is short so we can write more information in small place. In market the storage size of BD is 25GB to 50 GB is available.

d) Portable storage device (PSD): The portable Hard disk, flash drive (Pen drive), memory chips will come under this category. We can carry this storage unit with us while travelling.

Cache memory: The moving of data between the main memory and the CPU's register is one of the most time consuming operation. Because the main memory is less speed compare to our CPU's speed. The solution to this problem can be given by cache memory. **The cache memory is a small fast memory, which is between the CPU and the main memory.**

When a program is running and the CPU needs to read the data or instructions from RAM. The CPU first checks weather the data is in the cache memory. If the data is not there the CPU reads the data from RAM into its register. But it also loads the copy of the data into cache memory. The next time the CPU needs the same data it finds it in the cache memory and saves the time. The cache memory has 2 types one is level 1(L1) cache or primary cache and is built in within side of CPU. In addition to this the motherboard is also contain the cache and is called Level 2(L2) cache. At present the latest additional cache is present in the system board is called L3 cache. The size of L1 cache varies from 0.5KB to 512 KB. The size of L2 cache is varies from 512KB to 2MB.