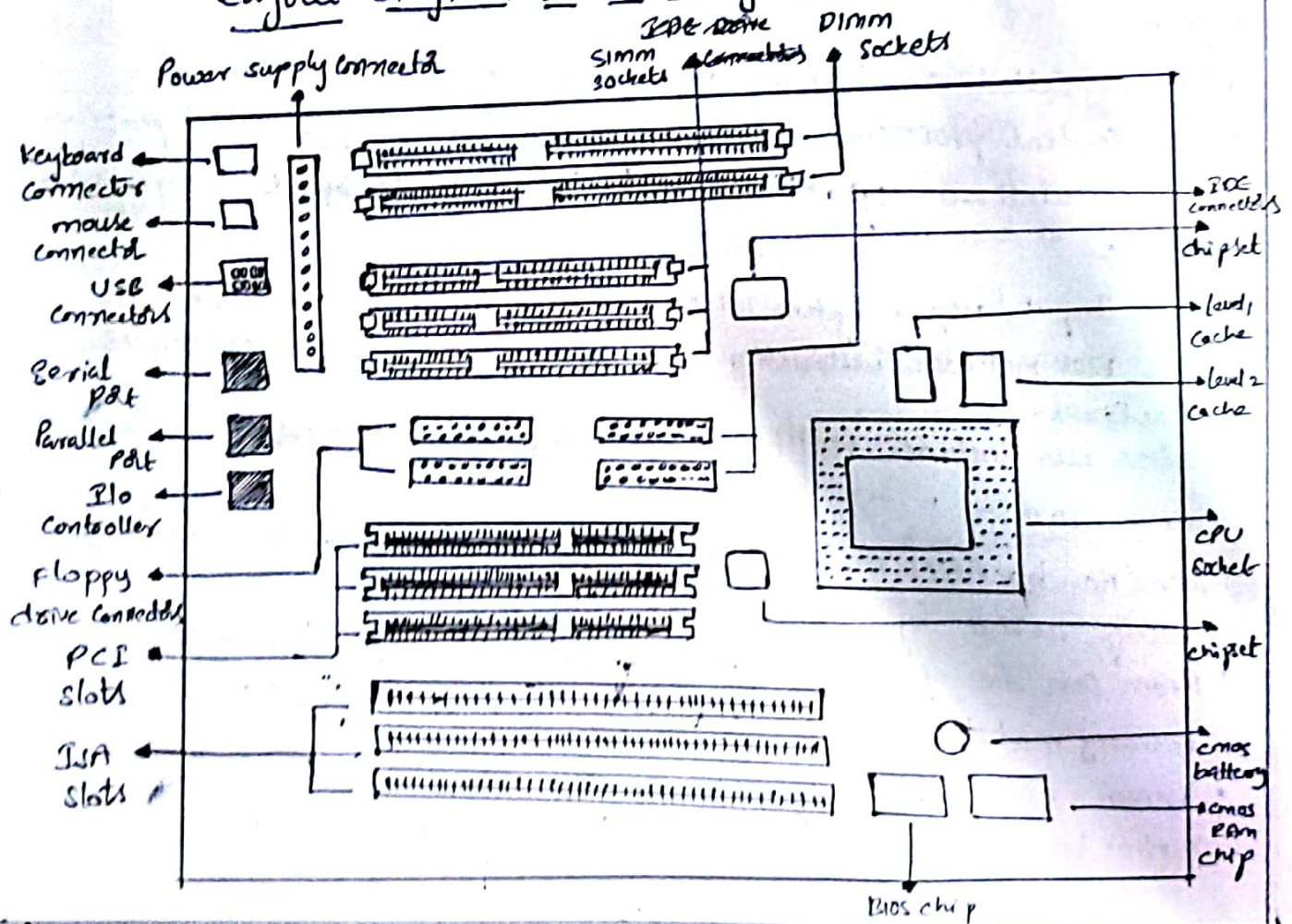


Ch-1 BASIC COMPUTER HARDWARE

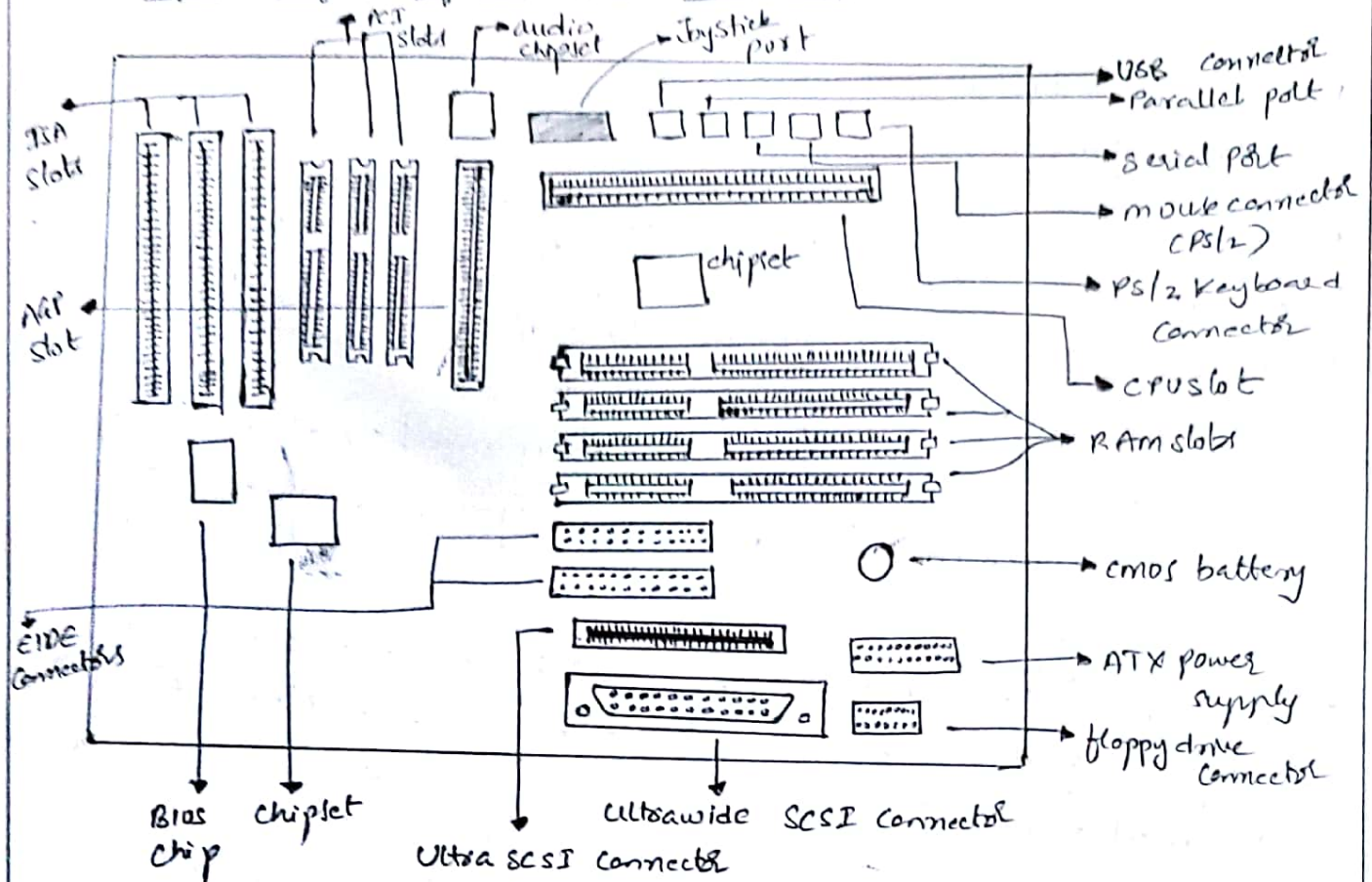
* COMPONENT LAYOUT OF PC-AT MOTHERBOARD AND FUNCTIONS OF EACH COMPONENT:

- Motherboard is most important part of any computer. It is considered as backbone of a computer.
- It is a PCB (printed circuit board) on which all electronic components of a PC are mounted.
- A motherboard connects CPU, memory, hard drive, optical drives, video cards, sound cards, expansion cards, ports, cables, etc.,
- There are large number of varieties in motherboards. Among all of them, two most widely used BABY AT and ATX motherboards.

Layout diagram of a baby AT motherboard



Layout diagram of an ATX motherboard



1. CPU:-

- It is called as "brain" of the computer.
- The central processing unit also called "microprocessor" performs all calculations, operations that takes place inside a computer.

2. BIOS:-

- Basic Input/output system is a ROM chip found on motherboards.
- This BIOS includes instructions on how to load basic computer hardware.
- BIOS also includes POST (power-on-self-test) to test computer hardware.

3. RAM SLOTS:-

- RAM (Random Access Memory) stores programs and data currently being used by the CPU.
- RAM can be placed in two types of sockets - SIMM (Single In-line memory module), DIMM (Dual In-line memory module).
- DIMM RAM's are only used in ATX motherboards, Baby AT motherboards support both SIMM and DIMM sockets.

4. CMOS RAM:-

- The CMOS (Complementary metal oxide semiconductor) RAM chip is used to store information about computer components, as well as settings for those components.

5. CMOS BATTERY (BACKUP BATTERY):-

- Normal RAM chips lose the information stored in them when power is no longer supplied to them.
- So, in order to retain the information in CMOS RAM chip, a lithium backup battery on motherboard supplies constant power to it.

6. BUS EXPANSION SLOTS:-

- PCI slots, ISA slots, AGP slots shown in layout are expansion slots.
- If you want to add a new device to computer, then you need an expansion slot.

7. IDE, EIDE, SCSI, SATA CONNECTORS:-

- These connectors used to connect hard disk drives to mother-board.
- IDE (Integrated Digital Electronics) - oldest type of connector used for hard drive connection.
- EIDE (Enhanced IDE) - used for connecting DMA (Direct memory access), multiple hard drives, CD drives.
- SCSI (Small Computer System Interface) - used to connect hard disks,
- SATA (Serial Advanced Technology Attachment) - new standard for connecting hard disk drives, optical drives, etc...

8. CHIPSETS:-

- The chipset is a group of chips like north bridge, south bridge which helps processor and other components on PC to communicate with and control all the devices plugged into motherboard.

9. I/O CONNECTORS:-

- Various I/O connectors are available on motherboard for various basic usage -

<u>I/O connector</u>	<u>Used to connect</u>
1. Serial Ports	Mouse, modem, etc.
2. Parallel Ports	Printers, Scanners, External hard drives, adapters, etc.
3. VGA port (Video Graphics Array)	Monitor
4. USB Ports	USB version of many different devices such as mouse, keyboard, scanners, cameras, printers, etc.

10. CACHE MEMORY :-

- It is the fastest memory, acts as interface between CPU and main memory.
- Frequently used data is placed in cache memory.
- Different levels are cache available like Level 1 (L1) cache, Level 2 (L2) cache, Level 3 (L3) cache.

*** LIST DIFFERENT EXPANSION SLOTS AVAILABLE ON THE MOTHERBOARD:

• EXPANSION SLOT : A socket on a computer motherboard where circuit boards like graphics card, NIC card, sound card, etc... can be placed, which is backbone of computer.

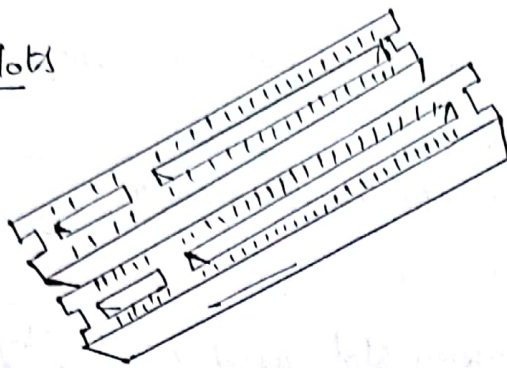
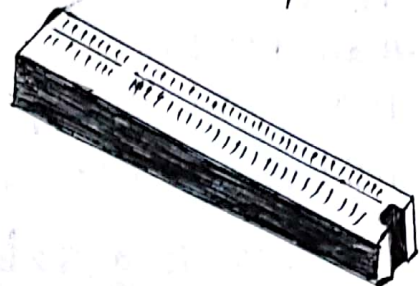
→ Address, data, control buses are connected to expansion cards through these expansion slots on motherboard.

→ Different types of expansion slots available on ^{motherboard} are -

- | | | |
|----------------------|---------------|-------------------|
| 1. PCI slots | 4. ISA slots | 7. PCI-X slots |
| 2. AGP slots | 5. EISA slots | 8. Mini PCI slots |
| 3. PCI express slots | 6. MCA slots | |

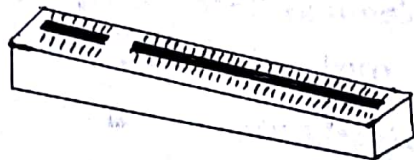
1. PCI SLOTS :- (Peripheral Component Interconnect)

- It is oldest standard which provides less bandwidth for expansion cards.
- Now, these slots are not used.
- PCI slots are used for expansion cards like - Sound card, network card, USB expansion cards, etc..

PCI slotsPCI e slots
(PCI express slots)

2. AGP SLOTS:- [Accelerated graphic port]

- AGP slots are used for placing video cards.
- These slots are designed when video cards are needed more bandwidth for performance which was not provided by PCI slots.



3. PCIe SLOTS:- [PCI Express]

- It is the new standard for expansion cards on personal computers.
- PCIe replaced older standards like PCI, AGP slots.
- These slots provides more bandwidth, allow high performance video cards, network cards.

4. ISA SLOTS:- [Industry Standard Architecture]



- These are 8 bit / 16 bit expansion slots, found in older computers.
- Now these are not used.

5. EISA SLOTS:- [Extended ISA]

- These are 32 bit expansion slots which is extension of ISA.
- These are older technology slots and are seldom used.

6. MCA SLOTS:- [Micro Channel Architecture]

- These are 32 bit expansion slot designed by IBM.
- It was also older standard.

7. PCI X SLOTS (PCI Extended) :-

- PCI Extended slot is a 32 bit bus slot with higher bandwidth than PCI bus.
- PCI X can run upto 4 times faster than PCI.

8. MINI PCI SLOTS :-

- Mini PCI is a 32 bit expansion slot used by Laptops
- Mini PCI has 3 different types - Type I, Type II, type III.

* FUNCTIONS OF CHIPSETS :-

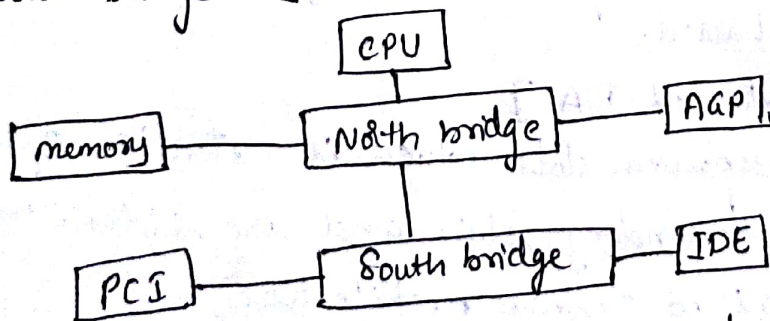
"A chipset is a group of chips that helps the processor and other components on the PC communicate with and control all of the devices plugged into motherboard".

The important functions of chipsets are -

- (i) The chipset controls the bits that flow between CPU and devices
- (ii) It controls system memory.
- (iii) It controls the motherboard's bus
- (iv) It manages data transfers between CPU, memory, devices.
- (v) It provides support for expansion bus and any power management features of system.

→ one chipset differs from another chipset depending on it has one, two (or) more chips in the "set".

→ A chipset having two chips called "North bridge" and "South bridge" shown below -



Here, North bridge is a chipset that controls main memory, Cache memory, PCI bus controller.

South bridge controls all the peripheral devices.

* FEATURES OF CHIPSETS :-

The features of five Intel chipsets are discussed below. They are -

- | | | |
|----------------------|----------------------|----------------------|
| 1. Intel 810 chipset | 3. Intel 820 chipset | 5. Intel 850 chipset |
| 2. Intel 815 chipset | 4. Intel 845 chipset | |

1. INTEL 810 CHIPSET :- It is intel's first chipset designed.

- It supports PCI buses
- It supports AGP slots for video and audio
- It supports Dual USB ports, IDE controller for I/O.
- It supports memory of size 512MB
- It doesn't support multicore.
- Pentium II / III Celeron processor is supported.

2. INTEL 815 CHIPSET :- It is updated version of 810 chipset.

- It supports PCI bus
- Pentium III / Celeron processor is supported.
- It doesn't support multiprocessors.
- It supports memory of 512MB of SDRAM
- It supports Two USB ports, UDMA IDE Controller for I/O.
- It Supports AGP slots for video and audio

3. INTEL 820 CHIPSET :-

- Pentium II / Pentium III processors are supported
- It supports multiprocessors (upto 2 processors)
- It supports memory size upto 1GB
- It supports PCI, USB, AGP buses.
- It supports AGP 4x for video, audio.
- It supports four USB ports for I/O

4. INTEL 845 CHIPSET :-

- Pentium III / Celeron processors are supported
- Multiprocessors upto 2 processors are supported
- Memory size upto 2GB of SDRAM supported

- A system bus of 900MHz supported
- For video and audio support AGP 4x devices used
- 4 USB ports, & high speed UART com ports used for I/O.

5. INTEL 850 CHIPSETS;

- It supports Pentium IV / Intel's Net Burst architecture processors
- Multiprocessors upto 2 processors are supported.
- 2GB of memory is supported.
- Four 100MHz system bus, 400MHz data bus is supported.
- AGP 4x devices, Six channels of audio supported for audio and video support.

*** SPECIFICATIONS OF PROCESSORS:-

The specifications of a processor are listed below:

- | | |
|---------------------------|---------------------------|
| 1. Clock speed | 9. Bus type |
| 2. Data bus width | 10. Level 1 (L1) cache |
| 3. Internal register size | 11. Level 2 (L2) cache |
| 4. Address bus width | 12. Level 3 (L3) cache |
| 5. Maximum memory | 13. Number of transistors |
| 6. Number of cores | 14. Thermal output |
| 7. CPU socket type | |
| 8. Working Voltage | |

1. CLOCK SPEED: (FREQUENCY)

The clock speed / frequency of a CPU is how many instructions being processed in one second and represented in MHz or GHz.

2. DATA BUS WIDTH:

This specifies the number of bits that the data bus of a processor can carry at a time.

3. INTERNAL REGISTER SIZE:

The size of the internal registers of a processor determines the maximum size of data unit with which processor can work.

Depending on internal register size, processors are classified as -

- 16 bit processors
- 32 bit processors
- 64 bit processors

4. ADDRESS BUS WIDTH:

The width of an address bus of a CPU determines the number of bits used for addressing any data stored at a location.

5. MAXIMUM MEMORY:-

It specifies the maximum total storage space supported.

6. NUMBER OF CORES:

This specifies the number of processors used.

- If there are two cores then it is called "Dual core processor."
- If there are 4 cores, it is "Quad core processor."

7. CPU SOCKET TYPE:

It specifies the type of socket LGA (or) PGA for which CPU is manufactured.

8. WORKING VOLTAGE:

It ^{represents} ~~represents~~ the DC voltages that the CPU requires for working.

9. BUS TYPE:

The bus type of a CPU is the way in which CPU cores communicate with rest of the system.

10. LEVEL 1 (L1) CACHE:

L1 cache memory has storage space between 32KB to 64KB. It has smallest space and size compared to L2 and L3 cache. It is fastest memory compared to L2 and L3 cache.

11. LEVEL 2 (L2) CACHE:

L2 cache memory has storage space between 256KB to 1MB. It has smallest space and size compared to L3, but more than L1 cache. It is fastest than L3 but slower than L1 cache.

12. LEVEL 3 (L3) CACHE :

L3 cache memory has storage space of 20MB to above. It has largest space and size than L1 and L2 cache. It is slower compared to both L1 and L2 cache.

13. NUMBER OF TRANSISTORS :

It specifies the number of transistors used in fabrication / manufacture of processor.

14. THERMAL OUTPUT :

It specifies the maximum ^{amount} number of power that the processor cooling system needs to dissipate.

* FEATURES OF DDR 2 SDRAM :-

1. Double data rate 2 SDRAM (DDR2 SDRAM) is improved version of DDR SDRAM.
2. It runs its external data bus at twice the speed of DDR SDRAM.
3. It has fastest performance.
4. It has 4 bit prefetch buffer.
5. It consumes less power and needs less supply voltage.

* FEATURES OF DDR3 SDRAM :-

1. Double data rate 3 SDRAM runs at faster speed compared to DDR2.
2. It runs at low voltage.
3. It has 8 bit prefetch buffer.
4. It has higher bandwidth performance effectively upto 1600 MHz.

* ACCELERATED GRAPHICS PORT : (AGP)

1. AGP is an interface that enables 3D graphics to display quickly on ordinary personal computers.
2. AGP is designed to convey 3D images much quickly and smoothly.
3. AGP is especially useful for 3D gaming, 3D videos, for sophisticated scientific and engineering graphics programs.
4. AGP was designed by Intel as an alternative to PCI.
5. AGP supports graphics controller to directly access the system memory (RAM).
6. AGP provides a dedicated bus for carrying graphics data.
7. AGP cards are able to render graphics faster than compared to PCI graphics cards.

* VARIOUS SMPS POWER SUPPLY CONNECTORS USED IN PC-AT :

The power supply used in the computer system is a "switch mode power supply (SMPS)". Various power supply connectors -

(i) AT MAIN POWER CONNECTOR :

- It is a motherboard power connector.
- It is a combination of two separate 6-pin connectors (P8 & P9)

Pinout description

P8 connector

<u>PIN.</u>	<u>WIRE COLOR</u>	<u>DESCRIPTION</u>
1	Orange	outputs +5V DC
2	red	+5V
3	Yellow	+12V
4	blue	-12V
5	black	Ground
6	black	Ground

P9 connector

<u>PIN</u>	<u>WIRE COLOR</u>	<u>DESCRIPTION</u>
1	black	Ground
2	black	Ground
3	white	-5V
4	red	+5V
5	red	+5V
6	red	+5V

(ii) ATX MAIN POWER CONNECTOR:

- Earlier ATX power connector has 20 pin configuration for connecting to motherboard, but current standard is 24 pin.

ATX 20 pin Main power Connector

<u>PIN</u>	<u>WIRE COLOR</u>	<u>DESCRIPTION</u>
1	orange	+3.3V
2	orange	+3.3V
3	black	gnd
4	red	+5V
5	black	gnd
6	red	+5V
7	black	gnd
8	gray	PWR-OK
9	purple	+5V
10	yellow	+12V
11	orange	+3.3V
12	blue	-12V
13	black	gnd
14	green	PS-ON #
15	black	gnd
16	black	gnd
17	black	gnd
18	white	-5V
19	red	+5V
20	red	+5V

ATX 24 pin main power connector

<u>PIN</u>	<u>WIRE COLOR</u>	<u>DESCRIPTION</u>
1	orange	+3.3V
2	orange	+3.3V
3	black	gnd
4	red	+5V
5	black	gnd
6	red	gnd
7	black	+5V
8	gray	PWR-OK
9	purple	VSB +5V
10	yellow	+12V
11	yellow	+12V
12	orange	+3.3V
13	orange	+3.3V
14	blue	blue -12V
15	black	black gnd
16	green	green PS-ON
17	black	blk gnd
18	black	gnd
19	black	gnd
20	white	-5V
21	red	+5V
22	red	+5V
23	red	+5V
24	black	+5V gnd

(ii) ATX 4 pin POWER CONNECTOR - 4 pin connector (P4 connector)

It is exclusively used for powering processor.

<u>PIN</u>	<u>WIRE COLOR</u>	<u>DESCRIPTION</u>
1	black	gnd
2	black	gnd
3	yellow	+12V
4	yellow	+12V

(iv) EPS +12VOLT POWER CONNECTOR:

- It is a 8 pin connector
- Initially this connector designed to provide 12V to power multiple CPU's.

<u>PIN</u>	<u>WIRE COLOR</u>	<u>DESCRIPTION</u>
1	black	gnd
2	black	gnd
3	black	gnd
4	black	gnd
5	yellow	+12V
6	yellow	+12V
7	yellow	+12V
8	yellow	+12V

(v) MOLEX CONNECTOR: [Peripheral connector] (4 pin connector)

It is used for connecting various devices like floppy drives, hard disks, video cards, etc.,...

<u>PIN</u>	<u>COLOR</u>	<u>DESCRIPTION</u>
1	yellow	+12V
2	black	gnd
3	black	gnd
4	red	+5V

(vi) SATA CONNECTOR:

- SATA includes both data connector and power connector.
- Modern power supplies will have at least 4 of these, to power up drives at SATA standard.
- It is a 15 pin connector

<u>PIN</u>	<u>COLOR</u>	<u>DESCRIPTION</u>
1	orange	+3.3V
2	orange	+3.3V
3	orange	+3.3V
4	black	gnd
5	black	gnd
6	black	gnd
7	red	+5V
8	red	+5V

9	red	+5V
10	black	gnd
11	black	gnd
12	black	gnd
13	yellow	+12V
14	yellow	+12V
15	yellow	+12V

(vii) PCI EXPRESS POWER CONNECTOR: (6 pin connector) [used to power video cards]

<u>PIN</u>	<u>COLOR</u>	<u>DESCRIPTION</u>
1	yellow	+12V
2	yellow/not connected	+12V/not connected
3	yellow	+12
4	black	gnd
5	black	gnd
6	black	gnd

(viii) PCI EXPRESS POWER CONNECTOR: (8 pin connector)

- Mainly used to power video cards
- 6 pin PCI express connectors provide power upto maximum 75 watts.
- This 8 pin PCI express connector provide power upto 150 watts.

<u>PIN</u>	<u>COLOR</u>	<u>DESCRIPTION</u>
1	yellow	+12V
2	yellow	+12V
3	yellow	+12V
4	black	gnd
5	black	gnd
6	black	gnd
7	black	gnd
8	black	gnd

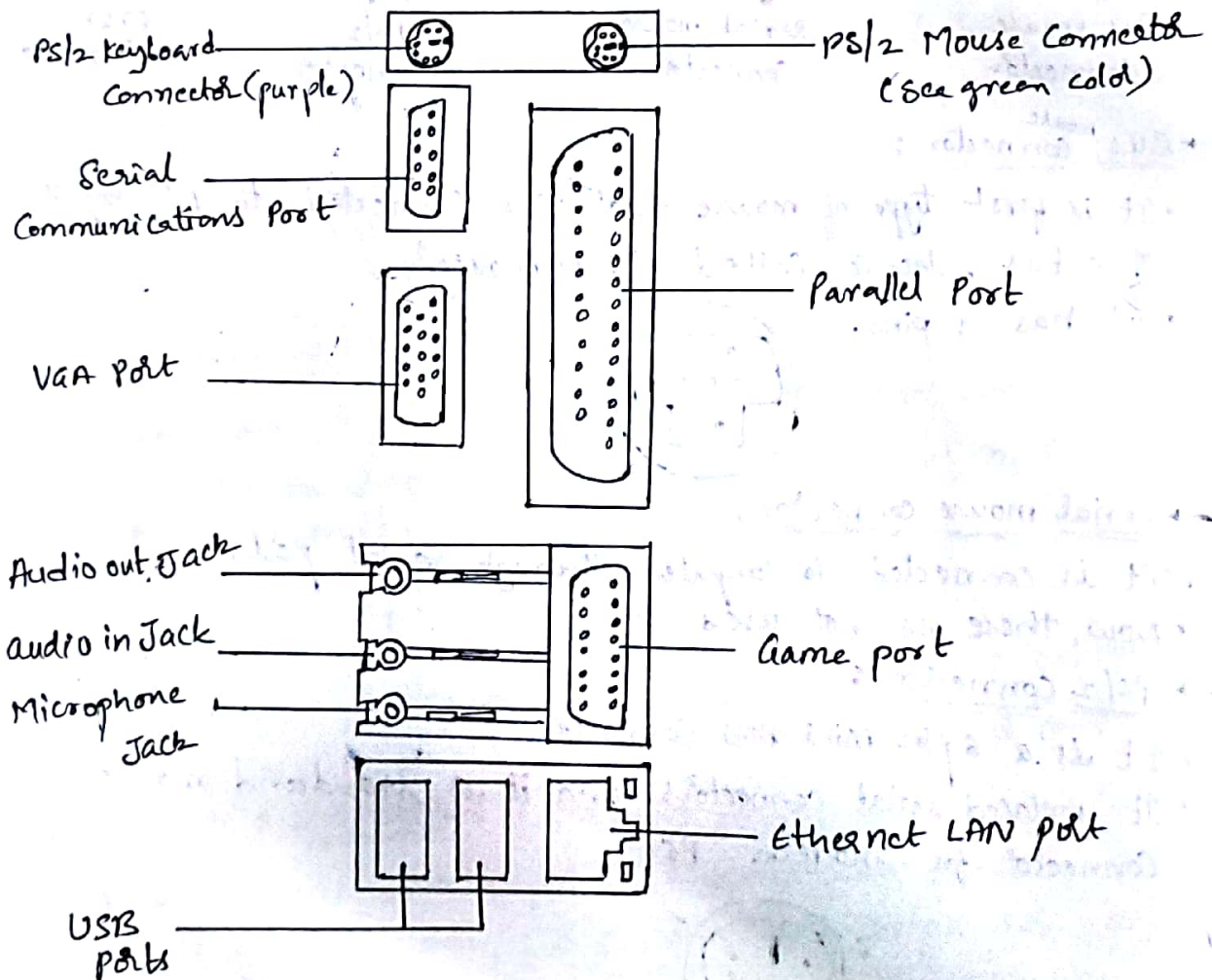
(ix) FLOPPY DRIVE CONNECTOR :

- These are also known as FDD connectors.
- It supplies power to floppy Disk Drives

* COMPUTER PORTS - SERIAL, MOUSE, KEYBOARD, USB PORTS:

In Computer hardware, computer ports are physical interfaces that connect a computer with external peripheral devices like monitor, printer, mouse, keyboard, etc.,...

→ There are several different types of computer ports - majority of them are located on back of computer case, while few of them like USB ports are on the front of most computer cases.

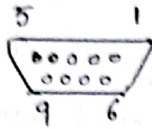


Let us see several connectors for mouse, Serial port, Keyboard, USB -

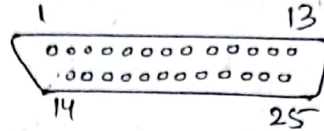
1. SERIAL PORT CONNECTORS:-

Serial Port Connectors

DB-9 pin connector



DB-25 pin connector



2. MOUSE CONNECTORS:-

- It is a dedicated socket / connector in computer for connecting a mouse.

Mouse connectors

Bus mouse connector

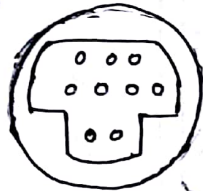
Serial mouse connector

PS/2 connector

USB connector

→ BUS mouse connector :

- It is first type of mouse that was connected to PC by use of a bus, hence, called "Bus mouse".
- It has 9 pins.

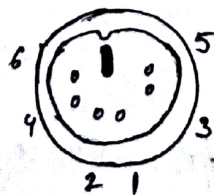


→ Serial mouse connector :

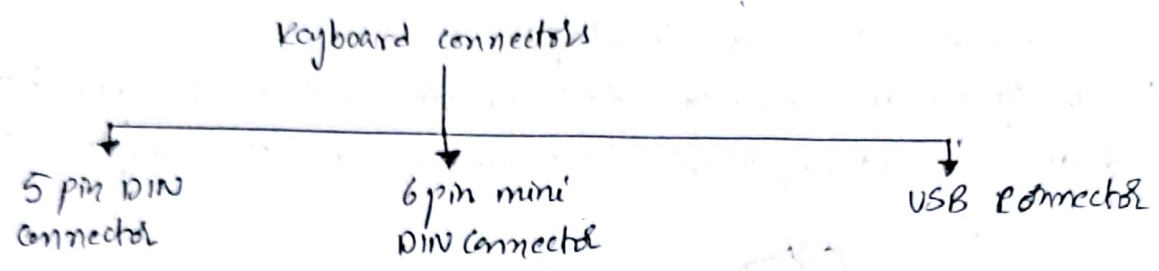
- It is connected to computer through serial port.
- Now, these are not used.

→ PS/2 connector :

- It is a 6 pin mini DIN connector.
- It replaced serial connectors and it is standard mouse connector for modern PC.

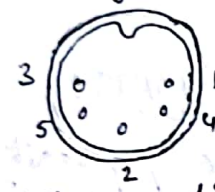


3. KEYBOARD CONNECTORS:



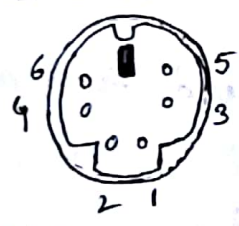
→ 5 pin DIN connector:

- It is oldest of all keyboard connectors.
- It is a bit larger than 6 pin DIN connector and not used now.



→ 6 pin mini DIN connector:

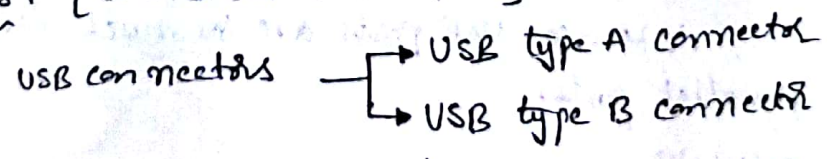
- It is also known as PS/2 connector (Personal Systems/2)
- It has 6 pins connector replaced 5 pin DIN, and used now.



→ USB connectors:

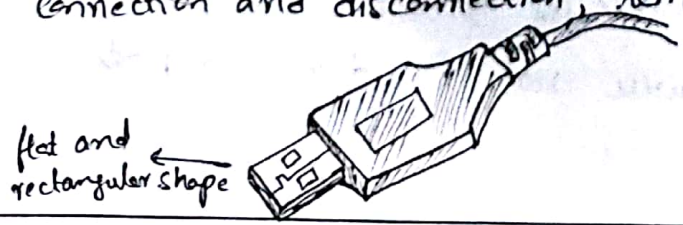
- These have replaced the above two DIN connectors
- Now all the modern keyboards come with standard USB plug unit.

4. USB CONNECTORS: [universal serial bus]



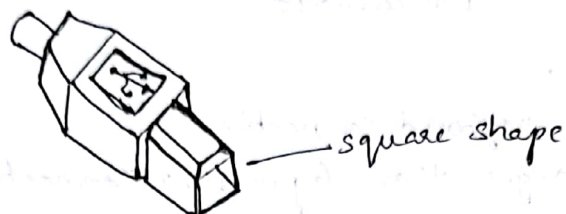
→ USB type A connectors: [Provides power]

- It is designed with a flat and rectangular shape.
- Instead of round pins, flat shape contact helps for easy connection and disconnection, removal very easy.



→ USB type B connectors :

- This connector is square in shape.
- This type B USB connector designed for used on USB peripheral devices (keyboard, mouse, video cameras, printers, adapters, etc.,).



* FOUR REASONS FOR POPULARITY OF USB PORTS :

There are 6 main reasons for wide popularity of USB ports. They are -

(a) High speed	(c) multiple Devices	(e) plug and play
(b) Reliability	(d) Self powered	(f) Hot-swappable

(a) High speed :

- Because of high data transfer speed, these are mostly preferred.

<u>USB version</u>	<u>speed</u>
USB 1.0	12 mbps
USB 2.0	480 mbps
USB 3.0	5 Gbps

- Serial ports mostly run at speed upto 115.2 Kbps
- Parallel ports run at speed upto 500 Kbps to 2 mbps.

∴ Hence, USB ports are too much faster than Serial and parallel ports.

(b) Reliability :

- USB ports are more reliable, since serial ports and parallel ports can subject to data loss.

- In serial ports data gets lost due to interrupts, In parallel ports, if cable is too long, data lost.

∴ These problems were not found in USB ports.

(c) Multiple Devices:

- A USB port can run many devices upto 127 in total.
- Hence, no longer to worry about having ports for new peripherals.

(d) Self-Powered:

- USB itself provides power to peripheral that we connect to it, so there is no need for external main power supply.

(e) Plug and Play:

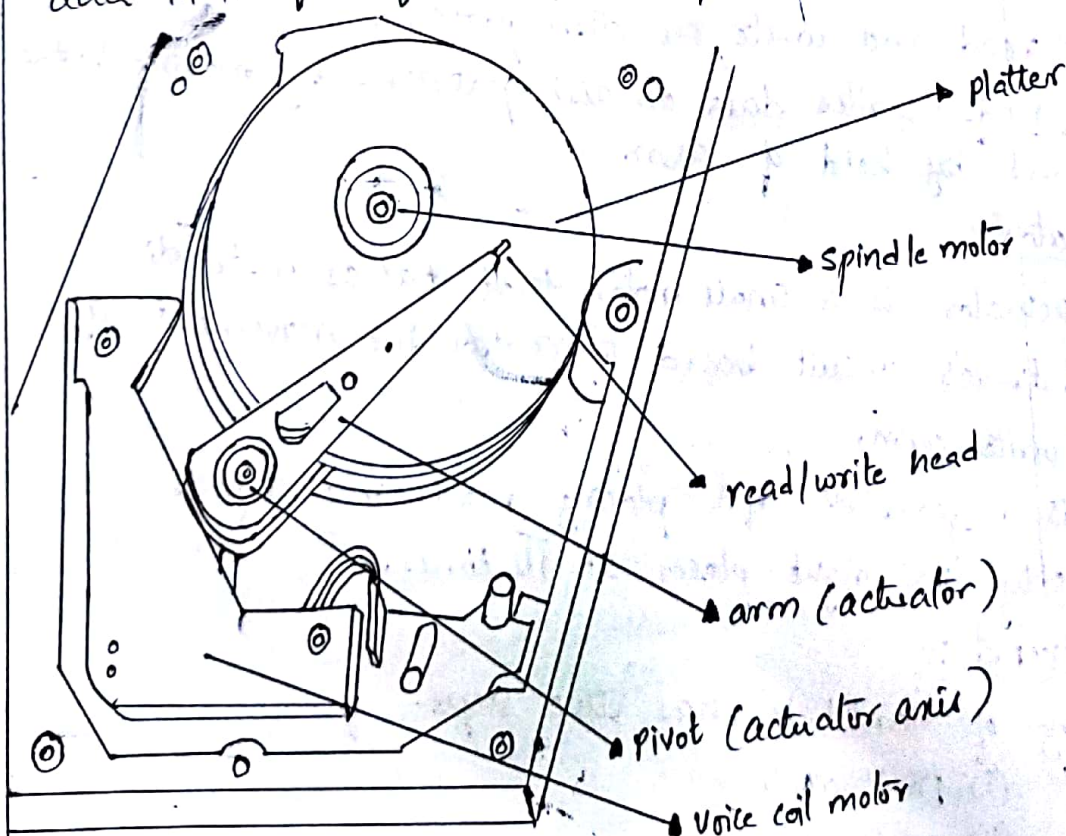
- When a USB connected, PC will automatically detect it. Hence, easy to install and connect, use.

(f) Hot-swappable:

- They can be connected (or) removed while PC is Switched on.

* WORKING OF HARD DISK AND DATA ACCESS:

The most popular internal storage used in computers is a "Hard disk". These are magnetic storage devices. These store data in the form of "magnetic patterns".



- The four main key components inside the hard disk are -
(a) platter (b) spindle (c) read/write arm (d) Actuator

(a) Platter:

- The platters are circular discs where 1's and 0's (data) stored.
- They are made of Aluminium, glass (or) ceramic and have magnetic surface in order to permanently store data.
- Data stored on platters in tracks, sectors, to keep it organized.

(b) Spindle:

- The spindle keeps the platters in position and rotates them as required.
- Spindle rotate by means of motor (generally stepper motor) at rate measured in revolutions/min, determines how fast data can be written to and read from hard drive.
- This spindle keeps platters at a fixed distance apart from each other to enable read/write arm to access them easily.

(c) Read/write Arm: (Head arm/actuator arm)

- Read/write arm controls the movement of read/write head, which read and write on disk patterns.
- Head reads/writes data on disk patterns by moving to the locations by help of arm.

(d) Actuator:

- The actuator is a small motor that takes instructions from drive's circuit board to control the movement of read/write arm.
- It is responsible for placing read/write heads exactly in right places at all times.

→ WORKING :-

Working of hard disk has two steps -

- (i) Disk writing
- (ii) Disk Reading

(i) DISK WRITING :-

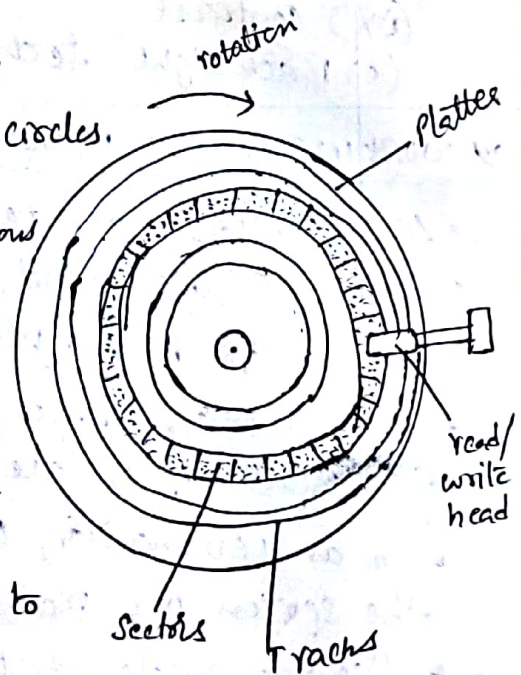
- Initially, when computer wants to write something on disk, then it sends signal to the hard disk controller to accept data. Also, CPU sends the location where it wants to write data.
- After receiving "write" signal from computer, the drive controller places read/write head over the desired location.
- Electronic circuits in the logic board of hard disk receives this data and convert it into magnetic pulses for storing on surface of disc.
- After completion of writing, disk controller generates an interrupt to indicate CPU that writing operation is done.

(ii) DISK READING :-

- Reading is done using Reverse process.
- The recorded magnetic pulses are converted to electrical signals and these electrical signals are then converted to meaningful data.

→ DATA ACCESS FROM HARD DISK :

- The circular platter divided into concentric circles known as "Tracks".
- Each track divided into several partitions known as "sectors".
- Each sector holds 512 bytes of data.
- Sector group is called "cluster".
- Data stores in sectors, tracks on both sides of platters.
- The process of reading from/writing to the sectors involves 2 steps;



(i) Read/write head moved to desired track. The position of head controlled by head actuator.

(ii) Next, spindle rotated by stepper motor that makes the sector to take position below the head correctly. Thus, reading and writing takes place.

* SPECIFICATIONS OF LED MONITOR:

Specifications of an LED monitor describes functionality of it -

(i) Resolution (like $\frac{1280 \times 720}{11}$, 1920×1080 , etc.,...)

no. of Horiz. Pixels $\times$ no. of vert. pixels

(ii) Screen Size (like 20", 21.5", 22", etc.,...)

(iii) Aspect ratio (width : Height ratio like 16:9, 32:9, etc.,...)

(iv) Display Panel type - (like IPS (in-plane switching) technology
TN (twisted nematic) technology
VA (A type LED) technology)

(v) Refresh rate (60Hz, 75Hz, etc.,...)

(vi) Response time (how quickly a pixel changes its color)

(vii) video Input Ports/Interfaces - HDMI, Display Port, VGA.

(viii) Brightness

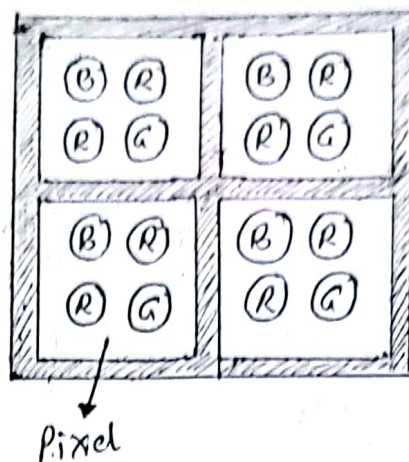
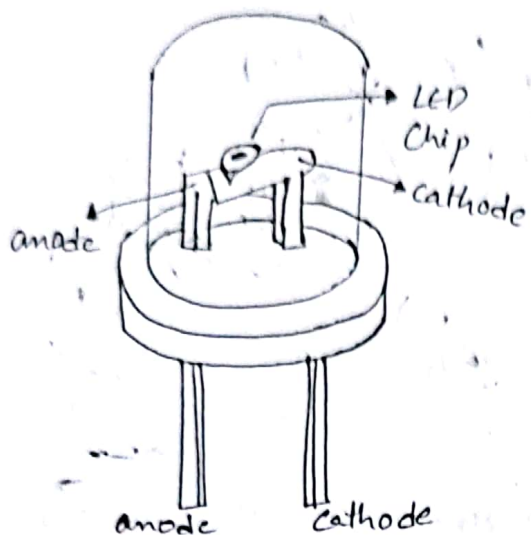
(ix) Contrast

(x) Backlight technology (OLED, LCD)

* WORKING OF LED MONITOR:-

- LED monitors are latest types of monitors now in market.
- These are flat panel, make use of LED's (light emitting diodes) for back lighting.
- LED monitors differ from LCD monitors where in LCD's fluorescent lights are used, here LED lights are used.
- On an LED monitor, LED's can be placed either behind the screen or around its edges.
- Viewing angle of LED greater than LCD.
- LED monitors run with greater energy efficiency, can provide a clearer, better picture, than general LCD monitors.

WORKING PRINCIPLE:-



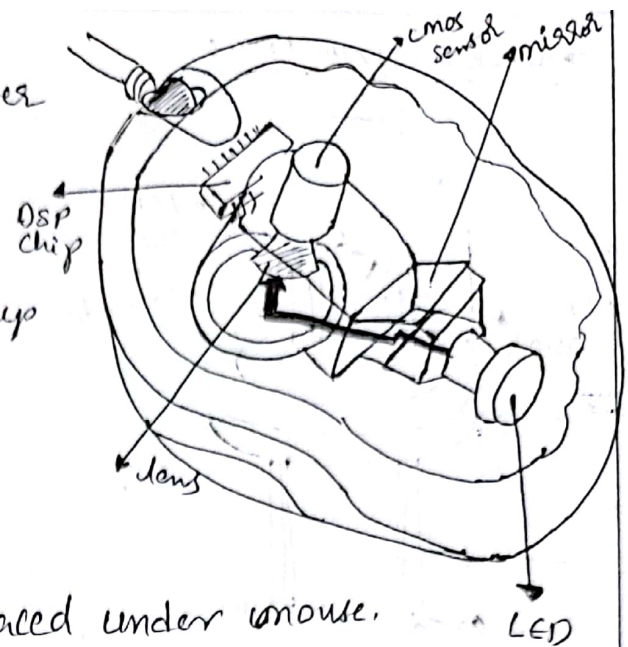
- An 'LED' works on principle of "Electroluminescence" - where light emits out when electron-hole recombines, where voltage supplied.
- LED's are made up of semiconductor materials like gallium, arsenide, aluminium, Indium, Thallium, phosphide (not silicon, Germanium)
- Depending on type of materials used for preparing LED, different colors of light emits out.
- LED display refers to light emitting elements which is composed by LED array, which is used as a pixel of Red, green, blue lights, thereby forming color picture on screen.
- The above figure is a pixel arrangement on a portion of a monitor screen with each pixel formed from four LED's (2 red LED's, 1 green LED, 1 blue LED)

* ADVANTAGES:

1. Consumes less power than LCD monitors
2. Produces images with higher contrast
3. Light weight, slim, flat design
4. Don't produce much heat while running

* WORKING OF OPTICAL MOUSE :-

- A mouse is a pointing device, when user rolls the mouse across flat surface, Screen "cursor" moves in direction of mouse's movement.
- The different components that make up an optical mouse are -
 - (a) optical eye
 - (b) micro camera
 - (c) DSP (Digital ^{signal} processing chip)



(a) Optical eye: (LED)

- It is nothing but an LED placed under mouse.
- It scans the surface.
- By projecting light onto surface, it scans.

(b) Micro Camera: (CMOS sensor)

- A CMOS (complementary metal oxide semiconductor) sensor serves as micro camera.
- It takes the pictures of surface that are scanned by optical eye (LED).

(c) DSP chip :-

- CMOS sensor sends images to DSP chip for analysis.
- DSP able to detect patterns in images and see how these patterns have moved / changed.
- It also detects the directions in which mouse moved.
- According to all analyzed data, it sends information to Computer.
- Then, Computer moves the cursor on screen based on data collected received from mouse.