UNIT - 5
INPUT OUTPUT

Peripheral Devices :- A computer Peripheral is a device that is connected to a computer but is not part of the core computer are the central Processing Unit. Power Supply. Mother-board and the computer case that contains Those three components.

Peripheral Devices can be external or Internal. for example, a Printer is an external device that you connect using a cable while an optical disc is typically located inside the computer case. Internal Peripheral devices are also referred to as integrated Peripherals.

Types of Peripherals Devices :-

(1) Input Devices :- An Input device sends data or Instructions to the computer such as a mouse, keyboard, graphics tablet. Image scanner, barcode reader, game

controller light Pen, light gun, microPhone digital camera, wabcam, read-only memory.

(2) Output device :- An output devices provides output from the computer, such as a computer monitor, Projector, Printer Head Phones and computer speaker.

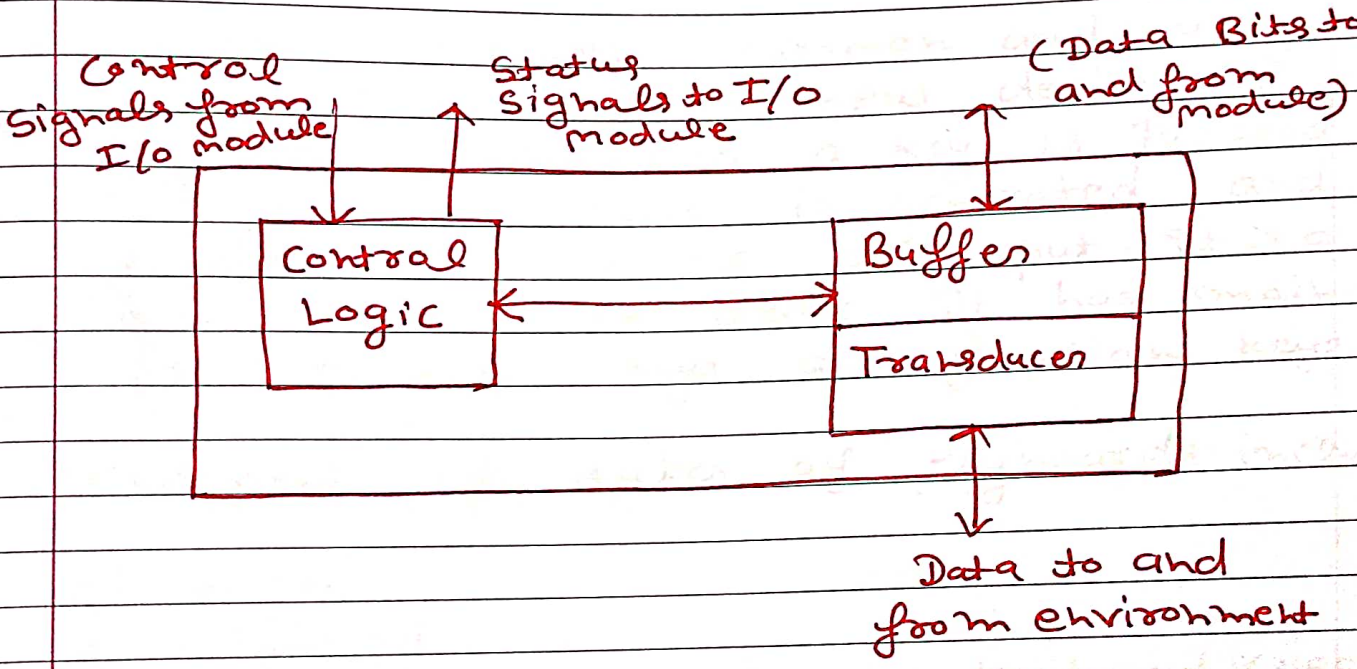
(3) Storage Devices :- An Input/output Device Performs input and output functions, such as a computer Data Storage device (including a disk drive, flash drive, memory card and tape drive.

we can broadly classify Peripherals into three categories.

(1) Human Readable :- communicating with the computer user example video Display terminal Printers etc.

(2) machine Readable :- communicating with equipments eg magnetic Disk, maghetic sensor etc.

(3) Communication :- communicating with remote devices, means exchanging data with them.
Examples - modem, NICC (Network Interface card) etc.



(Block Diagram of Peripheral Devices)

Control Signals Determine the function that the device will Perform such as send data to I/O module, accept Data from I/O module.

Status signals indicates the state of the Device.
Data bits are actual Data transformation.

Input Peripherals :- Input Peripherals is used to provide Data and Control signals to the information Processing system.
Examples of Input Peripherals :-

(1) Keyboard :- most common and very Popular input device is Keyboard. Whenever a key is Pressed an electric Pulse is generated and feeded to computers as input. It is a type writer like device. It has main keys, Numeric keys and functions keys.

Examples of types of keyboards include

⇒ Keyer
⇒ Keyboard
⇒ Lighted Program function keyboard (LPFK)

(2) Mouse :- A mouse is a cursor control device. A mouse is a smalle box a round ball at the bottom.

A mouse is a cursor control device. A mouse is a small box around ball at the bottom. A mouse is used to manipulate cursor on the screen.

Mouse cannot be used to enter text. Therefore They used in a conjuction with keyboard.

Output Peripherals:- output Peripherals are used to Provide the result of Processing to the user. Some of the most common output Peripherals are:

Monitor:- Monitor is the main output device of the computer. It consist of CRT (Cathode Ray Tube) which Display Characters as an output It form images from tiny dots called Pixels.

The Sharpness of the image dependson the number of Pixels.
There are two kinds of viewing Screen used for monitors.

(1) Cathode Ray tube
(2) flat - Panel Display.

Printer:- It is the most important output device which is used to Print information on Proper. Printers are of different types, Laser Printers, Inkjet Printers, Thermal Printers.

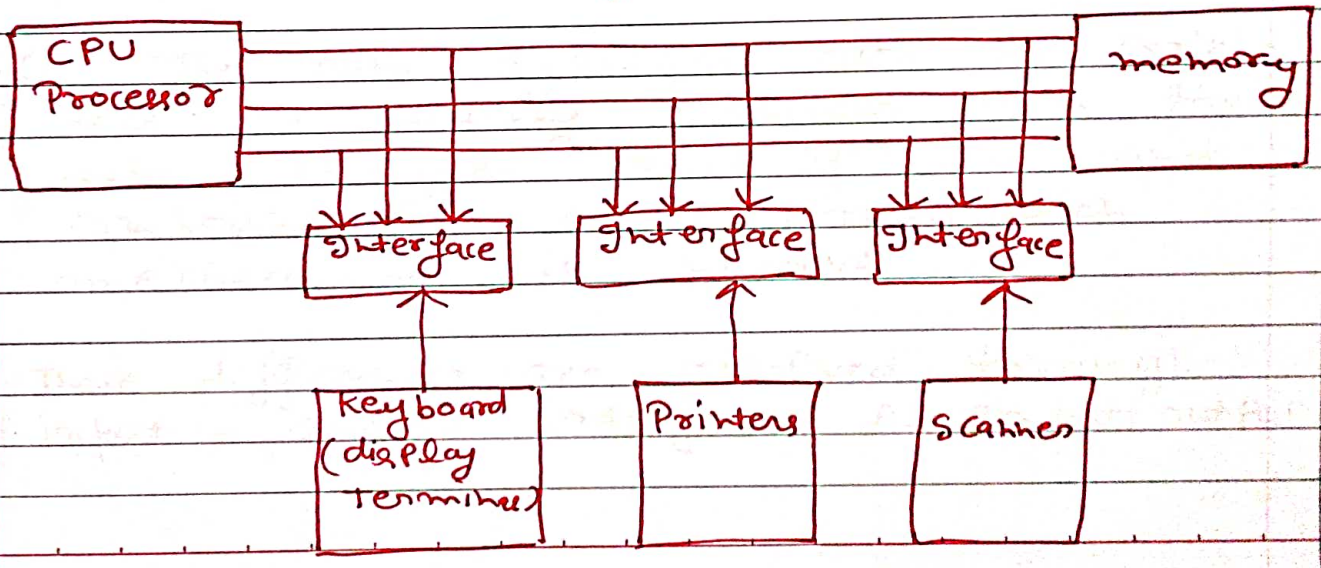
Input/output Peripherals:- Allow - both input as well output examples of I/O Peripherals - touch screen Head set etc.

Touch Screen:- A touch screen is the assembly of Both an input and output device. The touch panel is normally. Layered on the TOP an electronic visual display of an information Processing system.

INPUT - OUTPUT - INTERFACE :-

It is a Hardware circuit used between CPU and I/o devices to Superwise and Synchronize an input/output transfer. They Provide communication links between and Processor bus and Peripherals.

(Connection of I/o Bus to I/o device)



The Input/output interface is required because there exists many differences between the central computer and each peripheral while transferring information.

Some major differences are:

(1) Peripherals are electromechanical and electromagnetic device and their manner of operation is different from the operation of CPU and memory, which are electromagnetic device. Therefore a conversion of signal values may be required.

(2) The operation modes of Peripherals are differ from each other and cache be controlled so as not to distrub the operation of other Peripheral connected to the CPU.

(3) The Data transfer rate of Peripherals is usually slower than the data transfer rate of CPU and consequently a synchronisation mechanism is needed.

These differences are resolved through input - output interface As Input/output

interface connected various components each of which Perform one or more vital function for smooth transforming of information between CPU and Peripherals.

Input-output Bus and Interface module:-

In defines the typical link Between the Processor and several peripherals.

The Input/output Bus consists of Data lines, address lines and control lines. The I/O Bus from the Processor is attached to all Peripherals interface.

To communicate with a Particular device the Processor Place a device address on address lines.
each Peripheral has its own controller.

for example - The Printer has its controller controls the Paper motion, The Print timing.

The control lines are referred to as I/o commands The command are as following.

(1) Control command :- A control command is issued to activate the peripheral and to inform it what to do.

(2) Status command :- A status command is used to test various status conditions in the interface and the Peripheral.

(3) Data output command :- A data output command causes the interface to respond by Transferring data from the bus into one of its registers.

DATA Input Command :- A data input command causes the interface to respond by transferring data from registers to bus. Peripherals and Place it in its buffer register.

There are three ways that computer buses can be used to communicate with memory and I/O.

① Use two separate buses, one for memory and other for I/O.

(2) Use one common bus for Both memory and I/O bus separate Control lines for each.

(3) Use one common bus for memory and I/O with common Control lines.

INTERRUPTS :- As interrupts is a request for the Processor to interrupt currently executing code. So that the event can be Processed ina timely manner. if the request is accepted. The Processor will suspend its current activities save its state and execute a function called an interrupt Handler to deal with the event.

In other words transfer of Program Control from a currently running Program to Hardware and soft-ware generated signal request for the Processor. which creates a dist-urbance to a running Program. The disturbance is called an interrupt

Types of Interrupts :- if the interrupts can be various type but They are basically classifi-ed into Hardware interrupts and Software interrupts.

(1) Hardware interrupts :- if a Processor receives the interrupt request from an external I/o device. It is termed as a Hardware interrupt. Hardware interrupts are further divided into maskable and non-maskable.

(a) maskable Interrupts
(b) Non- maskable Interrupts.

(a) Maskable Interrupts :- The Hardware interrupt that can be ignored or delayed for some time if the Processor is executing a Program with Higher Priority are termed as maskable interrupts.

(b) Non- maskable interrupts :- The Hardware interrupts that can neither be ignored nor delayed and must immediately be serviced by the Processor are termed as non maskable interrupts.

(2) Software Interrupts :- The Software interrupts are the interrupts that occur when a condition is not or a systemcall occurs.

for ex- Some error instructions are generated to check the proper functions of the Program.

Supervisor call instruction generated a software interrupts, do switch from user mode to supervisor mode.

(a) Normal Interrupts :- The interrupts that are caused by the software interrupt instructions are called software Instructions.

(b) Exception :- Exception is nothing but an unplanned interruption while executing a program. for ex if we get a value that is divided by zero is called exception.

Types of exceptions :-

(1) Traps :- It is typically a type of synchronous interrupt caused by an exceptional condition.

(eg - breakpoint, division by zero, invalid memory access).

(2) Fault :- Fault exception is used in a

client application to catch contractually specified SOAP fault. By the simple exception message, you cannot identify the reason of the exception. That's why a fault exception is useful.

(3) Abort :- It is a type of exception occurs when instruction fetch causes an error.

Exceptions Example :-

There are three events that will trigger an exception : arithmetic overflow, undefined instruction, and system call.

(a) Arithmetic overflow :- occurs during the execution of an ADD or SUB instruction. If the result of the computation is too large or too small to hold in the result registed the event triggers an exception.

(b) Undefined Instruction :- occurs when an unknown instruction is fetched. The exception is caused by an instruction in the IR that has an unknown opcode or an R-type instruction that has an unknown function code.

(c) System Call :- occurs whe the Processor executes a syscall instruction, Syscall instructions are used to Implement operating System services (functions).

INPUT - OUTPUT PORT :- There are different types of Input- output Port.

⇒ Internal Port
⇒ external Port.

Internal Port :- Internal Port are used to connect the mother-board to internal devices like Hard-disk, CD-Drive, Internal modem etc.

External Port :- These Ports are used to connect motherboard with external devices like use, keyboard, mouse, Printer, Speaker, USB etc. (universal Port). Some Commonly used Ports are as following.

(1) Serial Port :- A Serial Port transmits one - bit of data at a time. Data is transmitted serially and ~~simp~~ single bit.

Thus a Serial Port Provides slow speed data transmission.
Serial Port is used to connect - external modem, Plotters Barcode, Readers etc.

These Ports commonly has 9-Pins or 25-Pins connectors.

(2) Parallel Port :- A Parallel Port is an interface for connecting 8-or more Data wires.

The Data flows through 8-wires simultaneously.

⇒ They can transmit 8-bits of Data in Parallel.
⇒ Thus ~~Parallel~~ Parallel Port Provides High-Speed Data transmission.
⇒ Parallel Port is used to connect Printer to the computer.

Parallel Port come in form of 25-Pins These are generally used to connect Printer and scanner.

USB - Port :- USB Stands for (Universal Serial Bus). It is the industry Standards for short Distance

Digital data connection. This Port can be used to connect a many types of Devices like Printer, camera, keyboard, Speaker, Pendrive, external Hard-disk.

PS-2 Port:- PS-2 Stands for Personal System/2. It is a female 6-Pin Port Standard. That connects to the male mini-DIN cable. PS/2 was Introduced by IBM to connect mouse and keyboard to Personal computers. This Port is now mostly through some Systems compatible with IBM may have this Port.

Infrared Port:- Infrared Port is a Port that enables wireless exchange of Data with a in a radious of 10 m. Two devices that have infrared Ports are Placed facing each other. So that beams of Infrared lights can be used to share data.

Bluetooth Port:- Bluetooth Port is a telecommunication specification that facilitates wireless connection between Phones, computers and other digital devices over Short range wireless connection. Bluetooth Port enables synchronization between

Bluetooth - enabled devices. There are two types of Blue-tooth Port.

(a) Incoming :- It is used to receive connection from bluetooth devices.

(b) Outcoming :- It is used to request connection to other Bluetooth Devices.

Firewire- Port :- Firewire Port is Apple computer's interface standard for enabling High- speed communication using for audio and video devices like camcorders.

CLASSIFICATION OF Interrupts :-

According to Periodicity of occurrence :-

(1) Periodic Interrupt :- if the interrupt occurred at fixed interval in timeline then that interrupts are called periodic interrupts.

(2) Aperiodic Interrupt :- if the occurrence of interrupt can-

not be Predicted then that interrupt is called aperiodic interrupt.

Classification of Interrupts According to the Temporal Relationship with System Clock :-

(a) Synchronous Interrupts :- The source of interrupt is in Phase to the System clock is called Synchronous Interrupt. In other words interrupts which are dependent on the system clock. Ex-timer service that uses the System clock.

(b) Asynchronous Interrupts :- if the interrupts are independent or not in Phase to the system clock is called asynchronous interrupt.

MODES OF TRANSFER :-

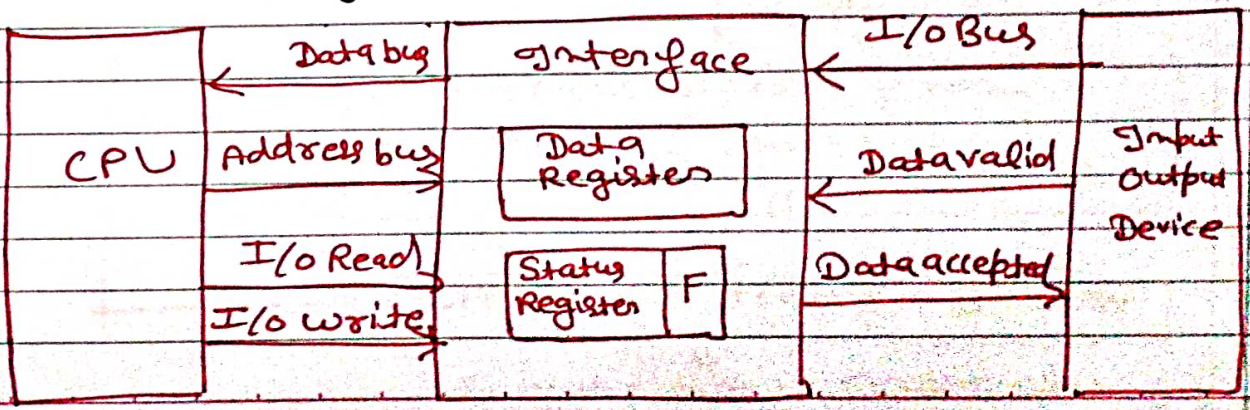
The binary information that is received from an external device is usually stored in the memory unit. The information that is transferred from the CPU to the external device is organized from the memory unit.

Data transfer between CPU and the I/O devices may be done in different modes.
Data transfer to and from the Peripherals may be done in any of the three Possible ways.

(1) Programmed Input-output
(2) Interrupt - Initiated Input-output
(3) Direct memory access (DMA).

(1) Programmed Input-output mode of Transfer:

It is due to the result of the Input/output Instructions that are written in the computer Program. Each data item transfer is initiated by an instruction in the Program. Usually the transfer is from a CPU register and memory. In this case it requires constant monitoring by the CPU of the Peripheral devices. So the CPU is kept busy unnecessarily.



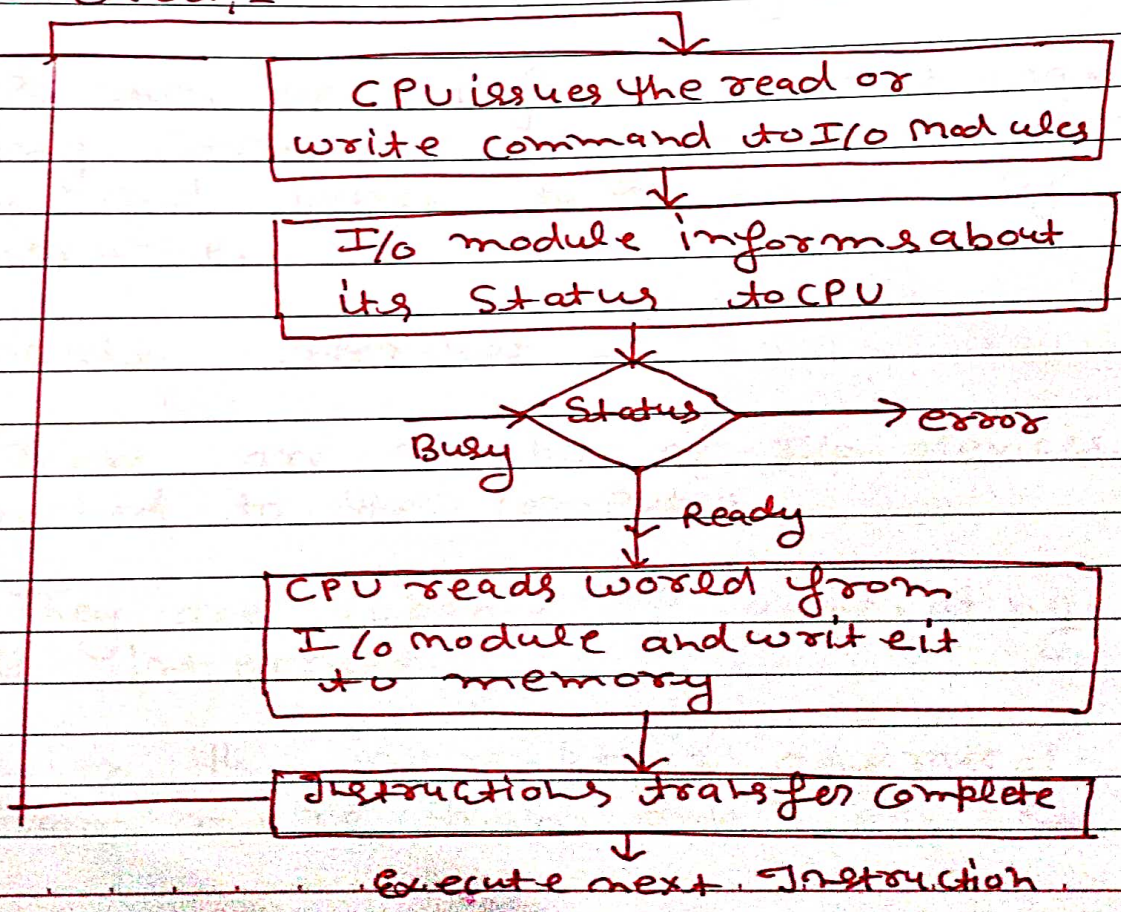
Drawback of Programmed Input/output :-

(1) The I/O transfer rate is limited by the speed with the Processor can test and service a device.

(2) The processor is tied up in managing an I/O transfer a number of instructions must be executed for each I/O Transfer.

(3) The CPU is kept-busy unnessarily.

FLow Chart :-



(2) Interrupt Initiated Input/output :-

In this method an interrupt facility an interrupt command is used to inform the device about the status and end of transfer. In the mean time the CPU executes other Program.

⇒ In this type of I/o computers does not check the flag it continues to Perform its task.

⇒ whenever any device wants the attention. It sends the interrupt signal to the CPU.

⇒ CPU then devices from what it was doing store the return address from PC and branch to the address of Subroutine.

Priority interrupt :-

⇒ There are number of I/o devices attached to the computer.

⇒ They are capable of generating the interrupt.

⇒ when the interrupt is generated from more than one device.

Priority interrupt system is used to determine which device is to be serviced first.

⇒ Device with High speed transfer are given highere Priority and slow devices are given Lower Prlority.

⇒ Establishing the Priority can be done in two ways.

(1) Using Software
(2) Using Hardware.

A Polling procedure is used to identify Highest Priority in software.

Polling Procedure (Using Software):-

There is one common branch address for all interrupts.

⇒ Branch address contain the code that Polls the interrupt sources in sequence. The Highest Priority is tested first.

⇒ The Particular service routine of Highest Priority device is served.

⇒ The disadvantage is that time required

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to Poll them can exceed the time to serve them in large in Large number of I/o devices.

Polling Procedure (Using Hardware):-

Hardware Priority System function as an overall manager.
It accepts interrupts request and determine the Priorities.

No Polling is required, all decision are established by Hardware Priority interrupt.
It can be established by serial or Parallel connection of interrupt lines.

Serial communication or Daisy Chaining Priority:-

Device with Highest Priority is Placed first.

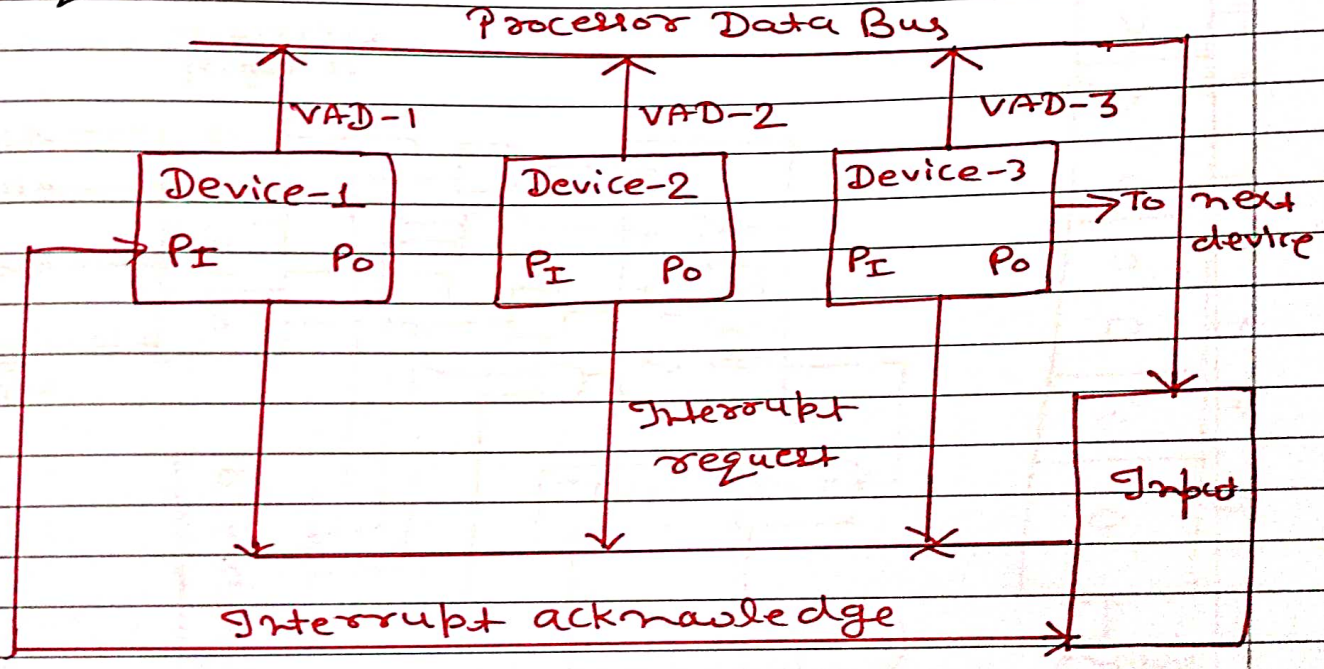
Device that wants attention sends the interrupt request to the CPU.

CPU then sends the INTACK Signal which is applied to PI (Priority in) of the first device.

if it had requested to attention. It Places its vectore address (VAD) on the bus and block the signal by Placing 0 in Po (Priority out).

⇒ if not it Pass the signal to next device through PI (Priority in) by Placing.

⇒ This Process whose PI is 1 and Po is 0 is the device that send the interrupt request.



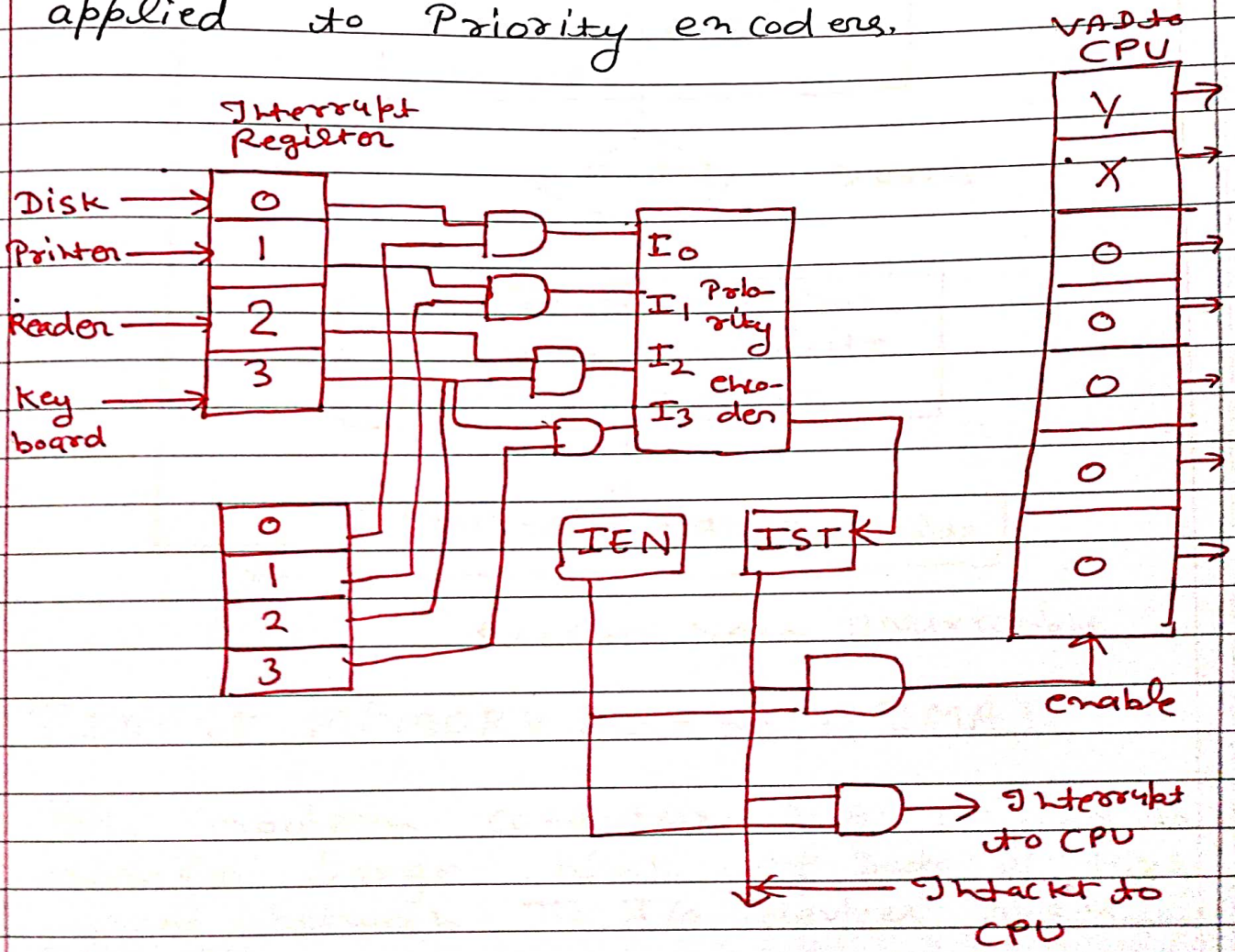
(Serial Communication)

PARALLEL PRIORITY INTERRUPT :-

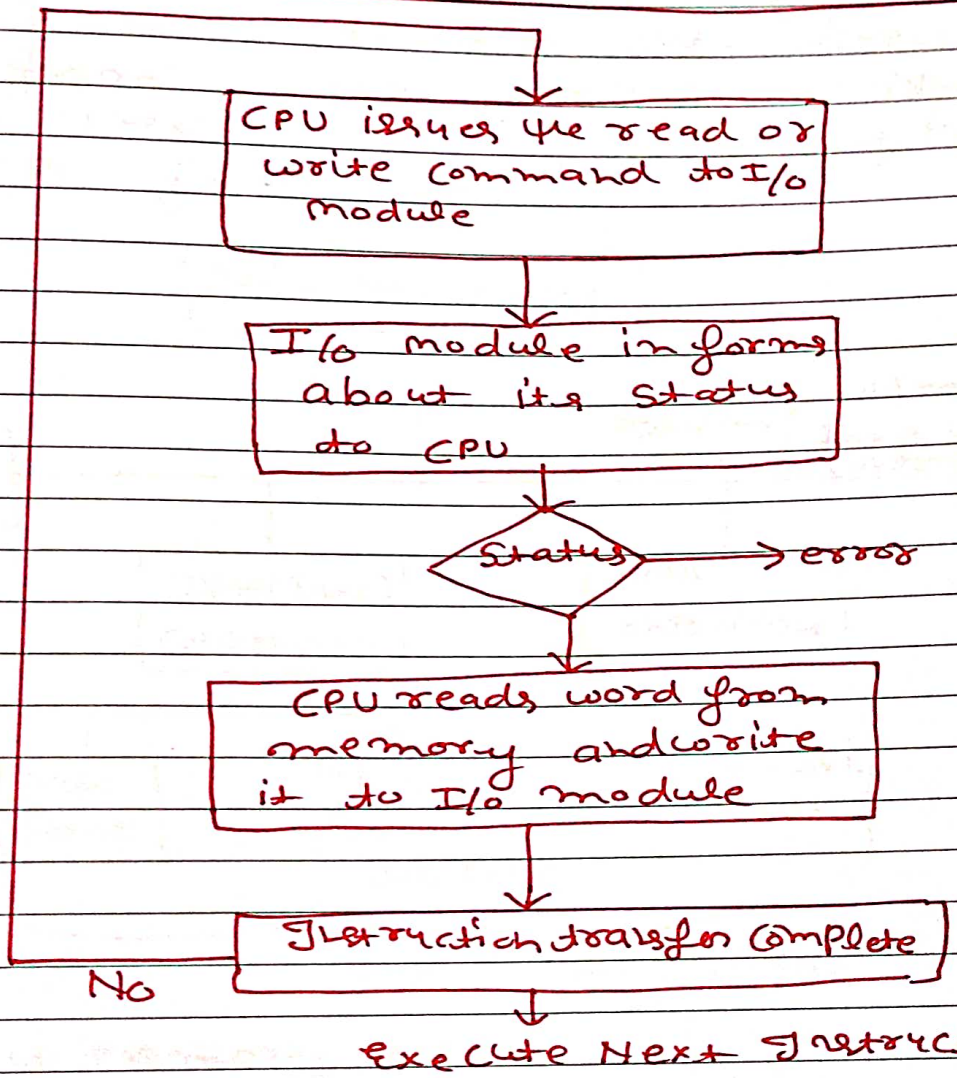
⇒ It consists of Interrupt register whose bits are set separately by the interrupting device.

⇒ Priority is established according to the position of Bits in the register.

⇒ According (corresponding interrupt bit and mask bits are added and applied to Priority encoders.



Execution Process of Interrupt - Initiated I/O is represented in FLOW CHART :-

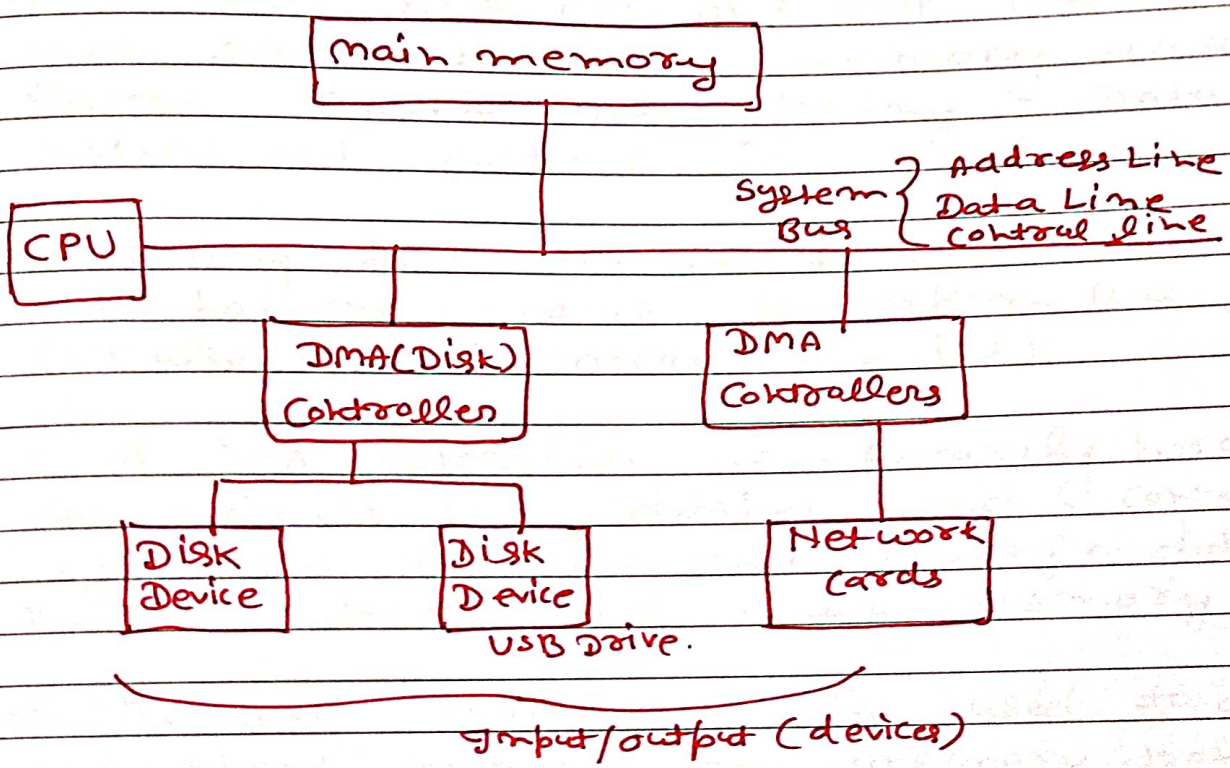


DIRECT MEMORY ACCESS (DMA) :-

In modern computers DMA is used to transfer large block of Data at High - Speed between the I/O devices and main memory.

DMA increases the data transfer Rate.

Definitions:- DMA allows I/O devices to transfer data directly to or from main memory, without CPU's intervention (or simply by passing the CPU from Path.).



Direct memory Access:-

⇒ The Direct memory Access (DMA) is a I/O technique that Provides direct access to the main memory while CPU is temporarily disabled to speed-up the memory operations.

⇒ The Process is managed by a chip know as DMA Controller (DMAc).

⇒ I/o Devices are connected to system bus via a special interface circuit called "DMA' Controller.

⇒ In DMA both CPU and DMA controller have access to main memory via a Shared System bus Having Data Address and control lines.

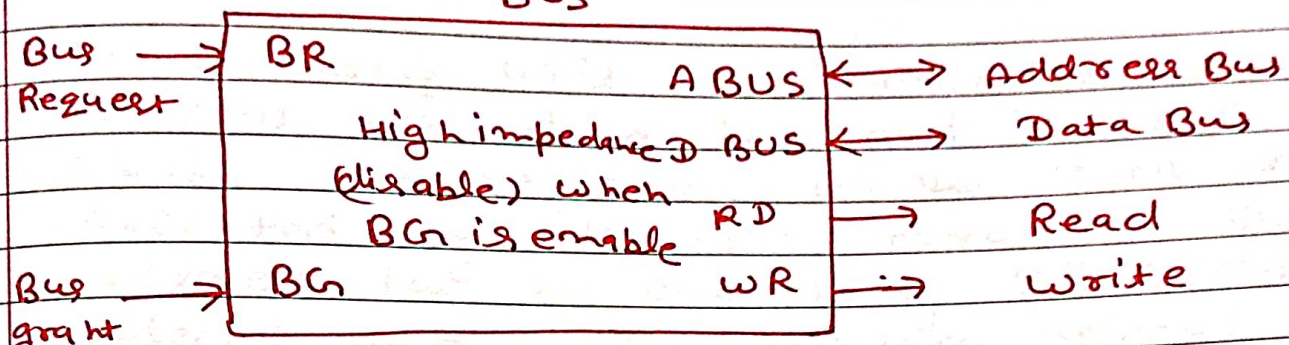
⇒ During DMA transfer the CPU is Idle and has no control of System Bus (or also called mean org bus).

⇒ A DMA Controller temporarily borrows the Address bus, databus, and control by from the CPU and transfer data b/w I/o devices and main memory.

⇒ The DMA transfer is also used to do High-Speed memory-to-memory transfer Ex- USB Drive.

DMA is Sometimes referred to as "DMA Channels. In an alternate Configuration DMA Controller may be incorporated directly into the I/o device.

The process is managed by a small chip known as a DMA Controller (DMAC).



(CPU Bus Signals for DMA Transfer)

The DMA controller needs the usual circuits of an interface to communicate with the CPU and I/O device. The DMA Controller has three registers.

(1) Address Register
(2) word count Register
(3) Count Register

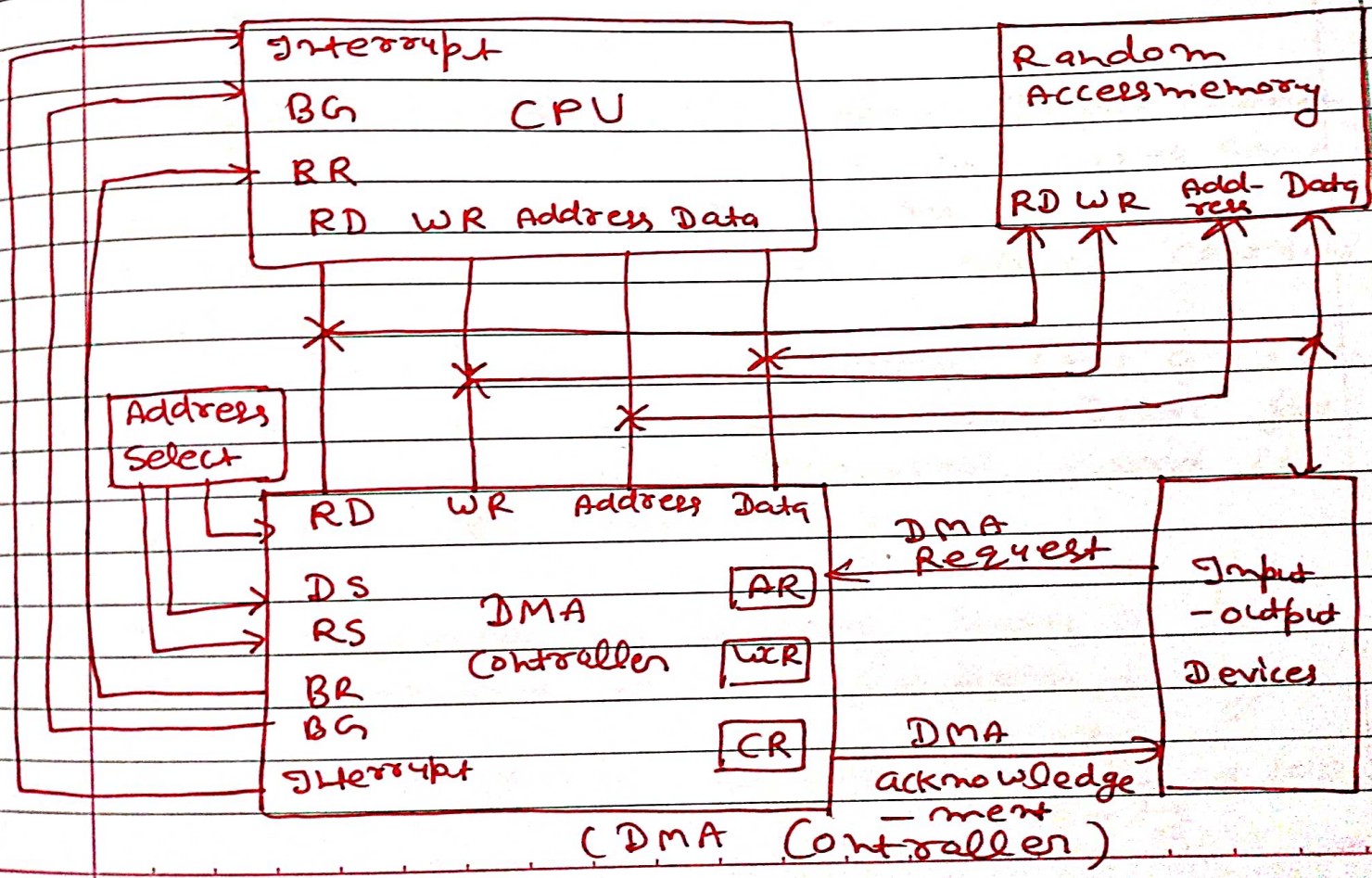
Address Register:- Address register contains an address to specify the desired location in memory.

word count Register:- we Holds the number to be transferred. The register is increment/decrement by one after each word transfer.

Control Register :- Control Register specifies the mode of transfer.

The memory unit communicates with the CPU via data bus and control lines. The registers in the DMA are selected by the CPU through the address bus by enabling DS (DMA Select) and RS (Register Select) inputs are bidirectional.

Block Diagram of DMA Controller :-



(DMA Controller)

DMA Transfer :- The CPU communicates with the DMA through the address and data buses. The DMA has its own address. which activate the modes of DMA transfer:

(1) Burst Mode
(2) Cycle Stealing
(3) Interleaving DMA

(1) Burst Mode :- Burst of Data is transfered before CPU takes the control of Data buses back.
⇒ Burst of Data could be entire Data, Burst of Blocks.

(2) Cycle Stealing :- Slow Input/output device takes some time to prepare the word.
⇒ During this time CPU keeps control of the buses.
⇒ one word is ready CPU gives the control of the buses to DMAC for 1 cycle in which Prepared word is transfer to memory.

Time required to Prepare Data = t_x
Time required to transfer Data = t_y

% of time CPU is blocked = $\frac{t_y}{t_x + t_y} \times 100$

for burst mode.

if transfer time is overlapped with Preparation time.

% of time CPU is blocked = $\frac{ty}{tx} \times 100$

(cycle stealing)

(3) Interleaving DMA :-

⇒ whenever CPU does not require system buses (doing internal work) the only control of the buses will be given to DMAC's.

⇒ CPU will not be blocked due to DMA.

⇒ maximum time required for data transfer as compared to Burst and cycle stealing mode.

⇒ Time required for data transfer :-

Interleaving > cycle stealing > Burst mode.

⇒ Speed of data transfer :-

Burst mode > cycle stealing > interleaving

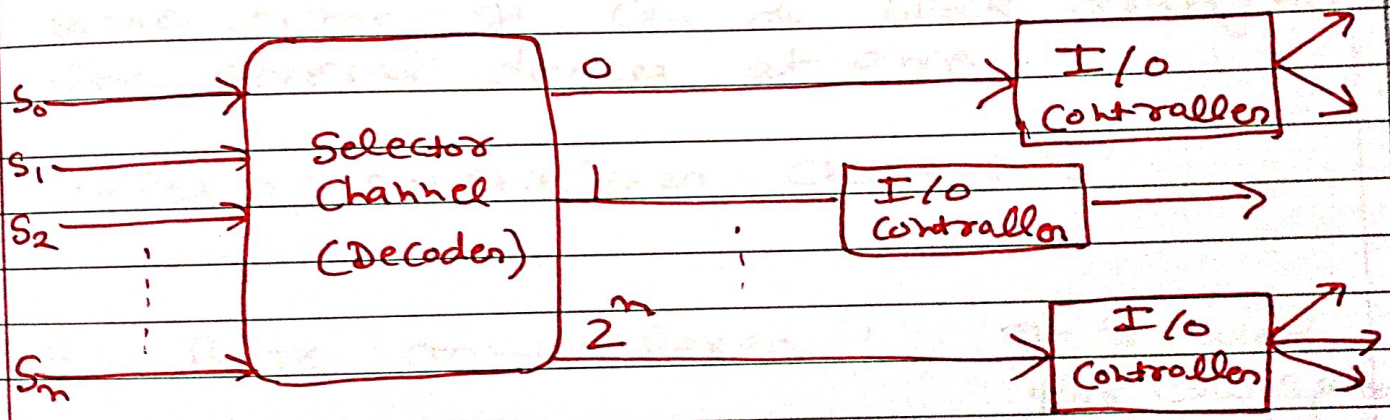
⇒ DMAC is a special Purpose Processor

which controls data transfer between memory and I/O (Because it generates add and control signals for memory.

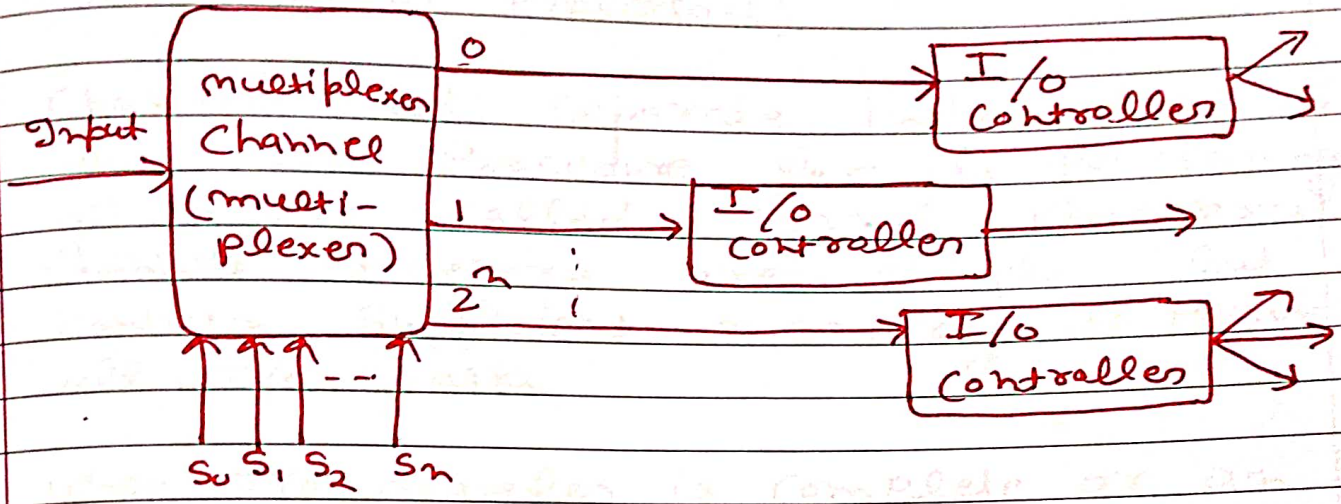
⇒ DMA could work even when instruction is executing.

INPUT-OUTPUT CHANNELS:-

(1) Selector Channel:- Selector Channel controls multiples High-speed devices. It is dedicated to the transfer of Data with one of the devices. In selector Channel each device is handled by a controller or I/O module. It controls the I/O controllers.



(2) multiplexer :- multiplexer channel is a DMA controller that can Handle multiple devices at the same time. It can do block transfers for several devices at once.



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Types of multiplexer - Channel :-

(a) Byte multiplexer :- It is used for Low-Speed devices. It transmits or accepts characters Interleaves byte from several devices.

(b) Block multiplexer :- It accepts or transmits block of characters. Interleaves block of bytes from several devices used for High-speed devices.

Input/Output Processors :-

Channels used separate, independent and low cost Procedure for its functioning which are called channel Processors. Channels Processors are simple. But contain sufficient memory to Handle all I/O tasks.

When I/O transfer is complete or an error is detected. The channel controller communicates with the CPU using an Interrupt and informs CPU about the error or the task completion - each channel supports one or more controllers or devices.

I/O Processors are also called I/O controllers,

Input/output Processor :-

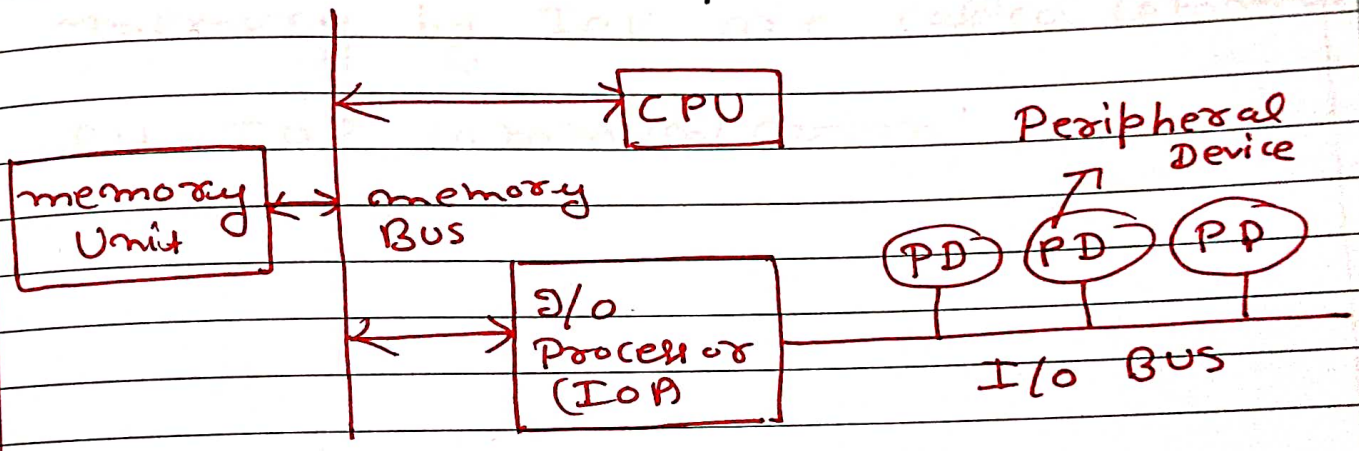
⇒ It is a Processor with direct memory access capability that communicates

with Input/output devices.

⇒ IOP is similar to CPU except that it is designed to Handle the details of I/O operation.

⇒ Unlike DMA which is initialized by CPU, IOP can fetch and execute its own instructions.

⇒ IOP instruction are specially designed to Handle I/O operation.



(Block Diagram of a computer with I/O Processor)

⇒ memory occupies the central position and can communicate with each Processing-or by DMA.

⇒ CPU is responsible for Processing Data.

⇒ IOP Provides the Path for transfer