

### Asynchronous transfer bus :

In an synchronous transfer bus the timing of the various signals are not guided by the master clock but by the hand shaking between the source and destination. Generation of handshaking signals always exist in asynchronous event that can not predict or control before accessing.

Modes of transfer of data, command and status :- there are three important

Modes of data transfer in the computer system

1. Programmed I/O data transfer
2. Interrupt driven I/O transfer
3. Direct memory access

1. Programmed I/O data transfer :- these technique are possible for I/O operations. With programmed I/O, data are exchanged between processor and I/O modules. The processor executes a program that give it direct control of I/O operations, including sensing device status, sending read and write command and transferring data.

Programmed I/O worked as follows:

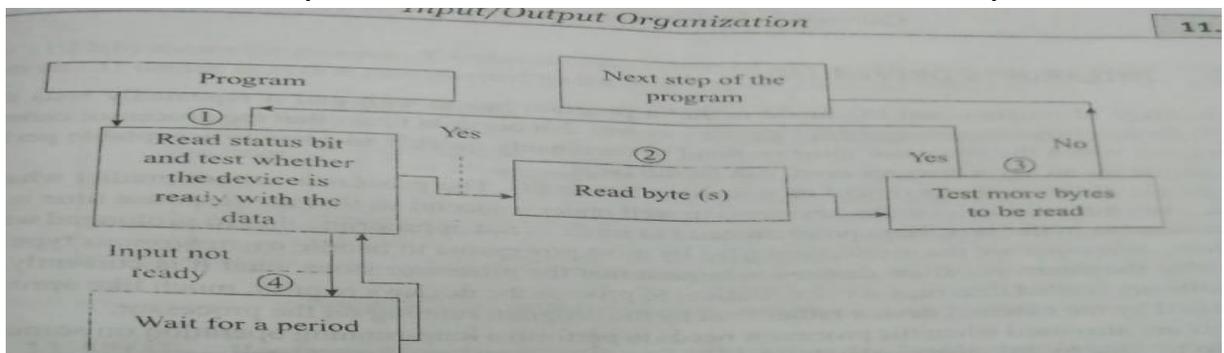
- a. Each input is read after first testing the device is ready with input or whether the device buffer is not empty
- b. Each output is written after first testing whether the device is ready to accept the byte .

The important command in programmed I/O are

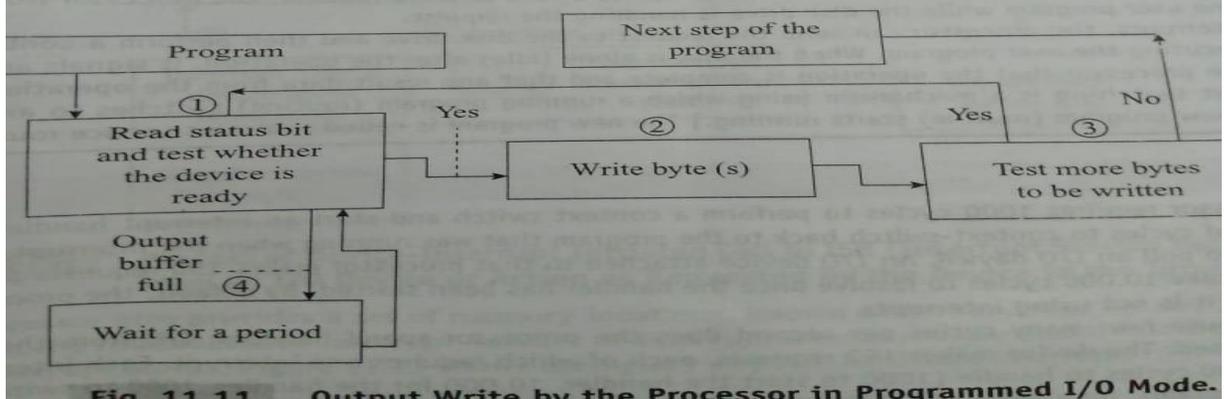
- a. Controls :- used to activate the devices and tell what to do .
- b. Test :- used to test various status condition associated with I/o Module and the device.
- c. Read :- used to accept the item of data from the device and place in internal buffer.
- d. Write:- used to take an item of data from the data bus and transmit that data item to the device.

Problem in Programmed I/O :

A major disadvantage of programmed I/O is that a program has to wait and it repeatedly tests the status . many I/O devices generate asynchronous events that occurs at times that the processor cannot predict or control but which the processor



**Fig. 11.10** Input Read by the Processor in Programmed I/O Mode.



**Fig. 11.11** Output Write by the Processor in Programmed I/O Mode.

must respond to reasonably quickly to provide acceptable

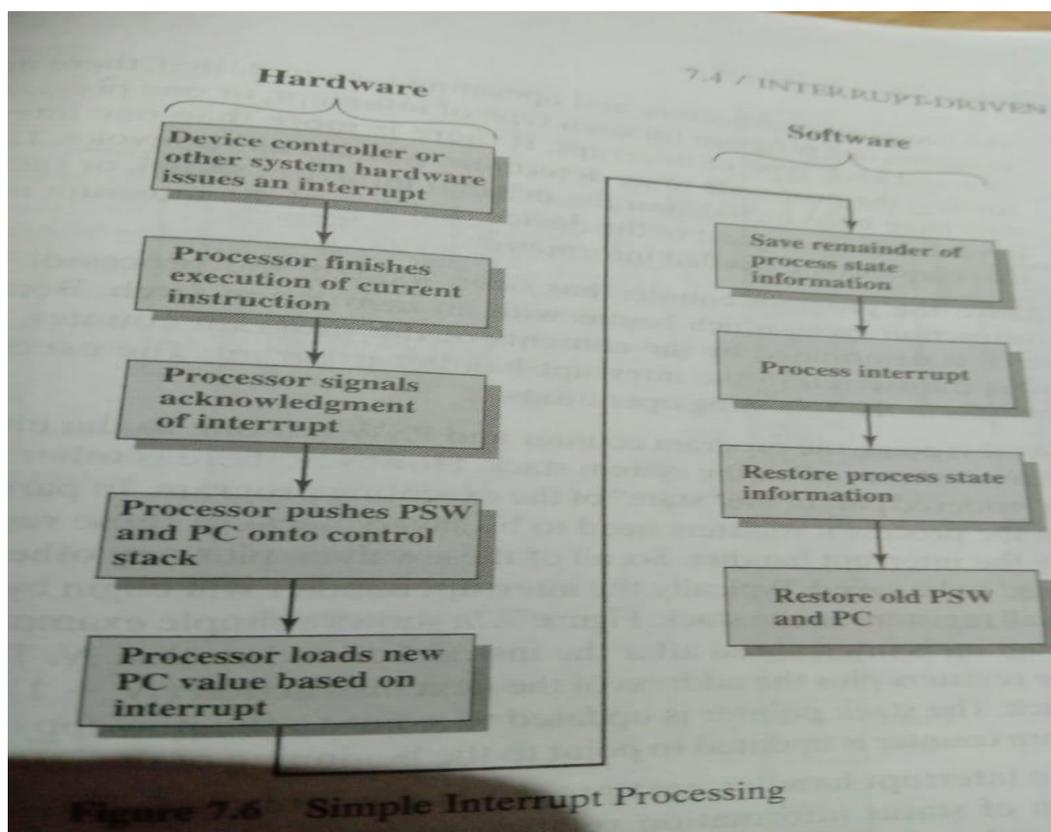
performance. Waiting period of asynchronous event can be too large.

## 2. Interrupt driven I/O data transfer :-

Interrupt are the mechanism used by most of processor to handle asynchronous type of events. The interrupt allow the devices to request that the processor stops what it is currently doing and execute software to process the device's request. It is just like a procedure call that is initiated by the external device rather than the program running on the processor.

Interrupt are also used when the processor needs to perform long running operations on some I/O device and wants to be able to do work while waiting to the operation to complete.

A simple interrupt processing may be shown as :-



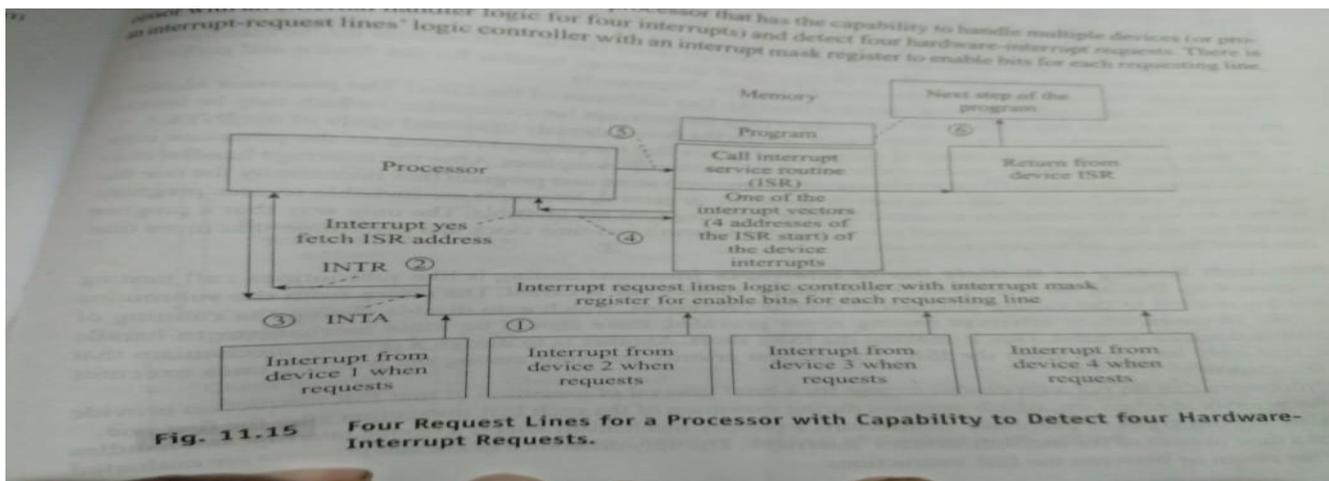
To implement interrupts , processor assigns a signal known as interrupt request signal(INIR or IRQ) to each device that can issue an interrupt.. each device assign interrupt acknowledge(INTA) that the processor uses to signal the device by interrupt request ISR. Processor also provide set of memory locations known as interrupt vector that store the program to execute after interrupt is known as routine or interrupt handler.

Processor may enable or disable the interrupt known as masking. There are two type of interrupt in I/O organization .

1. Nonmaskable interrupt -> the user program cannot disable the interrupt)
2. Maskable interrupt -> user program can disable the interrupt by instruction.

In case of multiple devices , there is an interrupt request lines , logic controller with an interrupt mast register to enable bits for each request line.

Multiple interrupt I/O organization may be shown as :-



Next step of the Program return from ISR

Draw back of the interrupt driven I/o organization .

The major drawback of interrupt driven I/O is that processor engaged during each i/O transfer even then interrupt based I/O operation is controlled by Interrupt controller. i.e

1. The I/O transfer rate is limited by the speed with which the processor can test and service the device.
2. The processor is tied up in managing the I/O transfer, a number of instruction must be executed for each I/O transfer.

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