ARCHITECTURE OF COMPUTERS

BLOCK 1:
LOGICAL ARCHITECTURE
OF COMPUTER

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ARCHITECTURE OF COMPUTER

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ROLE OF SELF INSTRUCTIONAL MATERIAL IN DISTANCE LEARNING

The need to plan effective instruction is imperative for a successful distance teaching repertoire. This is due to the fact that the instructional designer, the tutor, the author (s) and the student are often separated by distance and may never meet in person. This is an increasingly common scenario in distance education instruction. As much as possible, teaching by distance should stimulate the student's intellectual involvement and contain all the necessary learning instructional activities that are capable of guiding the student through the course objectives. Therefore, the course / self-instructional material are completely equipped with everything that the syllabus prescribes.

To ensure effective instruction, a number of instructional design ideas are used and these help students to acquire knowledge, intellectual skills, motor skills and necessary attitudinal changes. In this respect, students' assessment and course evaluation are incorporated in the text.

The nature of instructional activities used in distance education self-instructional materials depends on the domain of learning that they reinforce in the text, that is, the cognitive, psychomotor and affective. These are further interpreted in the acquisition of knowledge, intellectual skills and motor skills. Students may be encouraged to gain, apply and communicate (orally or in writing) the knowledge acquired. Intellectual-skills objectives may be met by designing instructions that make use of students' prior knowledge and experiences in the discourse as the foundation on which newly acquired knowledge is built.

The provision of exercises in the form of assignments, projects and tutorial feedback is necessary. Instructional activities that teach motor skills need to be graphically demonstrated and the correct practices provided during tutorials. Instructional activities for inculcating change in attitude and behavior should create interest and demonstrate need and benefits gained by adopting the required change. Information on the adoption and procedures for practice of new attitudes may then be introduced.

Teaching and learning at a distance eliminates interactive communication cues, such as pauses, intonation and gestures, associated with the face-to-face method of teaching. This is particularly so with the exclusive use of print media. Instructional activities built into the instructional repertoire provide this missing interaction between the student and the teacher. Therefore, the use of instructional activities to affect better distance teaching is not optional, but mandatory.

Our team of successful writers and authors has tried to reduce this.

Divide and to bring this Self Instructional Material as the best teaching and communication tool. Instructional activities are varied in order to assess the different facets of the domains of learning.

Distance education teaching repertoire involves extensive use of self-instructional materials, be they print or otherwise. These materials are designed to achieve certain pre-determined learning outcomes, namely goals and objectives that are contained in an instructional plan. Since the teaching process is affected over a distance, there is need to ensure that students actively participate in their learning by performing specific tasks that help them to understand the relevant concepts. Therefore, a set of exercises is built into the teaching repertoire in order to link what students and tutors do in the framework of the course outline. These could be in the form of students' assignments, a research project or a science practical exercise. Examples of instructional activities in distance education are too numerous to list. Instructional activities, when used in this context, help to motivate students, guide and measure students' performance (continuous assessment)

PREFACE

We have put in lots of hard work to make this book as user-friendly as possible, but we have not sacrificed quality. Experts were involved in preparing the materials. However, concepts are explained in easy language for you. We have included may tables and examples for easy understanding.

We sincerely hope this book will help you in every way you expect.

All the best for your studies from our team!

ARCHITECTURE OF COMPUTER

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ARCHITECTURE OF COMPUTER

BLOCK 1: LOGICAL ARCHITECTURE OF COMPUTER

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Block Introduction

Computer architecture is referred to as a deep study of data and information along with its processing and execution. The main work of a computer is to give instructions and to return the desired output. For this purpose, it uses different hardware and software that plays an important role. It is interesting to see how a computer uses our information and by utilising its technology, gives us the output. We see that once the hardware is ready, now it's time to use it by the way it understands. So this block stresses on the execution, decoding and carrying out the information a computer system understands.

In this block, you will study and learn more about internal hardware structure of a Computer. In this the knowledge regarding data that you entered can be stored for longer duration. The concept related to Memory and Processor is well explained. The knowledge related to data storage in secondary and primary memory will help students to learn more.

After studying this block, user will be able to understand about processor and its functional features. The students will be demonstrated with logical architecture of a computer system that will create interest about the computers on which they used to work. The necessary hardware details will make them aware regarding data calculation, transmission and manipulation of data with more basic facts about Registers, ALU, Internal Bus, Read/Write Cycle of Memory, Internal Bus, Control Unit, Cache Memory, etc. The block gives diagrammatic explanation which will help the students to work of their own.

Block Objective

After learning this block, you will be able to understand:

- The various Computer Hardware components required for its processing.

- How information is received and saved.

- Loading and unloading of programs in storage devices.

- How a computer executes the information.

Block Structure

UNIT 1: INTRODUCTION TO MEMORY AND PROCESSOR

Unit Structure

1.0   Learning Objectives

After learning this unit, you will be able to understand:

- The Computer Memory and Processor

- The Hard Disk

- About loading of programs into Memory

- About storing of data into Hard Disk

1.1   Introduction

In this unit, we will learn about the basics of a Computer Processor and its working. It is studied that computers do not understand high level languages, so the need of a processor exists as only a processor will be able to judge the instructions encoded in binary form. In order to execute a program, a computer processor receives the instruction from the computer memory and tries to execute it. A processor performs certain instructions as its basic operation which is kept in the main memory of a Computer system. A processor impacts the total computing power and performs most of the computer's operation. In multiprogramming system, a virtual memory is required to do this work. We say that memory is just a part of a Computer system that remembers things for the CPU.

1.2   Preliminary Overview of Processor

A processor, also known as Central Processing Unit (CPU), is the brain of a Computer which understands and performs many basic instructions that helps in operating a Computer system. The first processor was invented by Intel in 1971 which is a 4 Bit device having a speed of 108 KHz. A Processor contains thousands or millions of small switches known as transistors. In mainframes and supercomputers, the different functions done by the processor expands from an individual chip to multiple circuit boards, where as in a personal computer, the functions of the processor are normally on a single chip. All computers, large and small, must have a processor or central processing unit
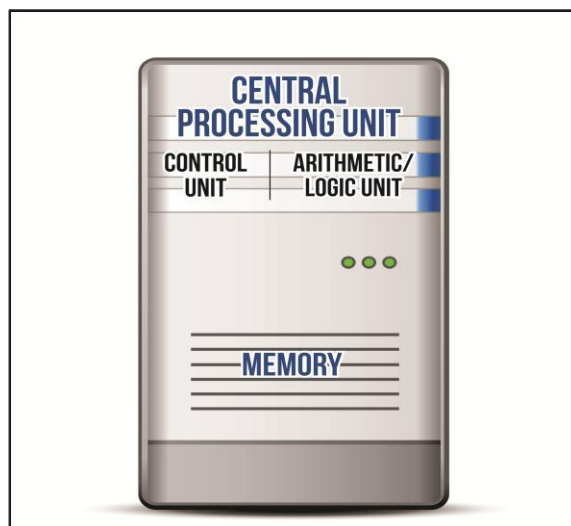
Fig. 1.1 Layout of Processor

Figure 1.1 shows the layout of a processor (CPU). Its main part includes:

- Arithmetic logic unit (ALU)

- Registers

- Control unit

We see that the ALU is termed as Arithmetic logic unit which performs arithmetic and logic operations. The register stores the bits of information supplied to the object on which the operations are to be performed and passes them to the ALU and further keeps the result of the ALU operations. The control unit gets the instructions from memory and perform the operations by directing the matched operations of the ALU registers and other components.

A processor operates with a speed of an internal clock when a current is applied. The main function of a processor is to carry out a series of stored instructions which are known as programs. For every instruction, the processor uses the following set of basic operations which is known as machine cycle.

1. Fetches the instruction or data from memory.

2. Decodes the instructions into commands as understood by the computer.

3. Executes the commands.

4. Stores the result in the memory.

Advantages

1. It performs fast calculation of mathematical data.

2. It controls the configuration of tiny switches known as transistors.

3. It controls the overall working of peripherals.

Check your progress 1

1. The first processor was invented by_____.

   a. Intel   c. Apple

   b. Microsoft   d. Unix

2. Which is not a part of processor?

   a. Arithmetic logic unit (ALU)   c. Registers

   b. Memory   d. Control unit

1.3   Memory and Hard Disk

In any computer system, both memory and hard disk play an important role. Memory is a temporary storage place for data, instructions and information. It stores the operating system, application programs and processed data. Whereas, a hard disk is a spindle of magnetic discs which holds numerous gigabytes of data. It stores the information permanently. It is seen that any stored data is lost in the memory if the power is switched off whereas the data remains permanent in the Hard disk even if you switch off the computer system. Let us discuss both in details.

1.3.1   Memory

Memory is a part of a computer system that temporarily stores information that is required by the processor or CPU. Since CPU cannot do any job without a memory so memory contains small flat boxes of chips which are same as CPU chips containing memory devices instead of CPU circuits. While working, a CPU needs both: an information to be manipulated and instructions that tells the CPU to perform actions on that particular information. Finally the memory holds these things and provides it to the CPU whenever the CPU asks for it. It is seen that everything stored in the memory will wipe off when you have switched off the Computer System.

Computer memory is similar to our brain as it stores the data and instruction. It is located inside the computer and is placed on the motherboard. It is located in a particular area in the computer system where the data is calculated and the instructions are stored. The memory is divided into several small memory parts like cells. Each cell has a different address which varies from 0 to -1.

Memory is mainly of three types:

- Cache Memory

- Primary Memory

- Secondary Memory
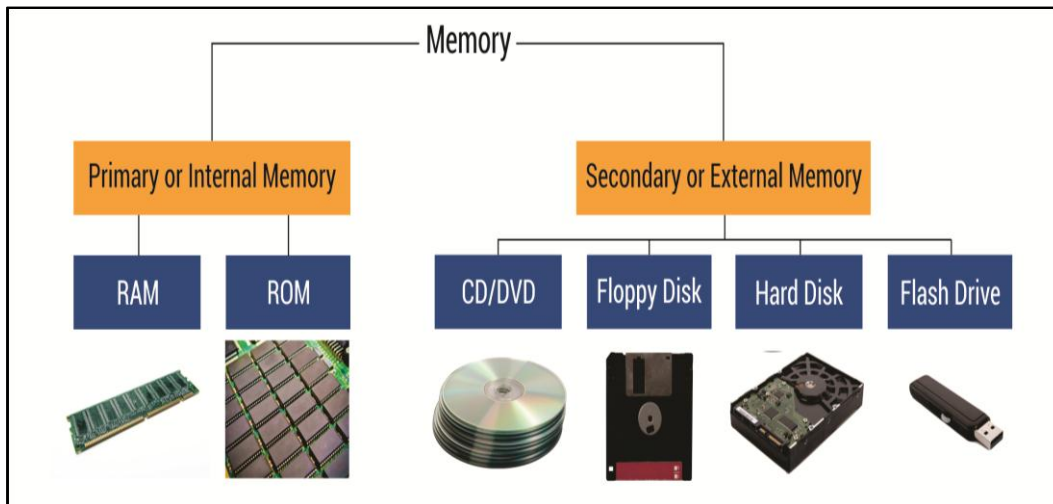
Fig. 1.2 Types of Computer Memory

1. Cache Memory

It is a type of high speed computer memory used for CPU to perform the work faster. It serves as a buffer between the CPU/processor and main memory. Such memory holds the data and the program that are required by the CPU/Processor. It has certain advantages and disadvantages.

Advantages

- Much faster

- Requires less working time

- Stores particular programs to be performed for a short period

- Stores data for short-term purpose

Disadvantages

- It has low capacity.

- It is expensive.

2. Primary Memory

Primary memory is the main memory of the computer. Such memory keeps that part of the data and instructions on which the computer works currently. It has less capacity. It is a volatile memory in which the data gets erased when the power is switched off.

It is of two types:

- RAM – It is known as Random Access Memory. It is the main working memory that is used by the computer.

Fig. 1.3 RAM

- ROM – It is known as Read Only Memory. It is a special type of memory that keeps the software that can only be read but cannot be written.

Characteristic

- Such type of memory is a semiconductor memory.

- It is the main memory of computer.

- It is not stable.

- In this, the data gets erased when power is switch off.

- It is the working memory of a computer.

- It is faster than any other memory.

- Without such memory, the computer system cannot work.

3.   Secondary Memory

Secondary memory is a type of external memory which is also known as non-volatile memory which is particularly used to store data and information. This type of memory is slower than primary memory or the main memory. Because of its non-volatile characteristics, the data or the information remains inside it permanently even after the power is switched off.
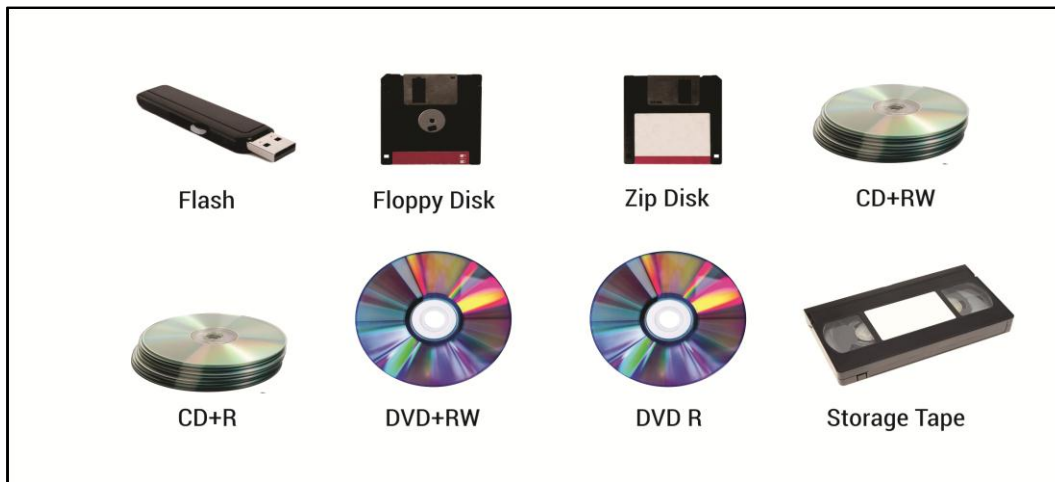
Fig. 1.4 Types of Secondary Memory

Figure 1.3, shows the different types of Secondary memories, which are:

- Hard disk

- CD-ROM

- DVD

- Flash drives

- Zip drives

- Storage tapes

Characteristic

- It is a type of magnetic and optical memory.

- It is commonly known as backup memory.

- In this, the data remains permanently inside it even after the power is switched off.

- Without this memory, the computer can run easily.

- It is slower than the primary memory.

Measuring Computer Memory

You can measure the Computer memories with the help of:

- **Bit:** It is the smallest unit of measurement of computer memory that stores the binary numbers 1 or 0.

- **Byte:** A byte is a collection of 8 bits.

- **Kilobyte:** A kilobyte (KB) consists of 1024 bytes.

- **Megabyte:** A megabyte (MB) consists of 1024 kilobytes.

- **Gigabyte:** A gigabyte (GB) consists of 1024 megabytes.

1.3.2 Hard Disk

A hard disk drive is the device which is used to store large amounts of information permanently of up to 500 GB. Hard disk drives are used to store operating systems, software and data. It is attached inside the computer system.

Fig. 1.5 Hard disk

Hard disk is a permanent storage place which is best for any application which requires very fast access to data both in the case of reading and writing. On the other hand, it is seen that, hard disk drives are not proper for applications that require portability. Nowadays, almost every computer system is installed with a fixed hard disc that can be used for on-line and real time processes with direct access to the computer system. Hard disks are used in file servers for computer networks to store large amount of data and information. It is seen that the capacity of 1 Hard Disk is equal to 7, 50,000 Floppy Disk's space.

Fig. 1.6 Hard Disk

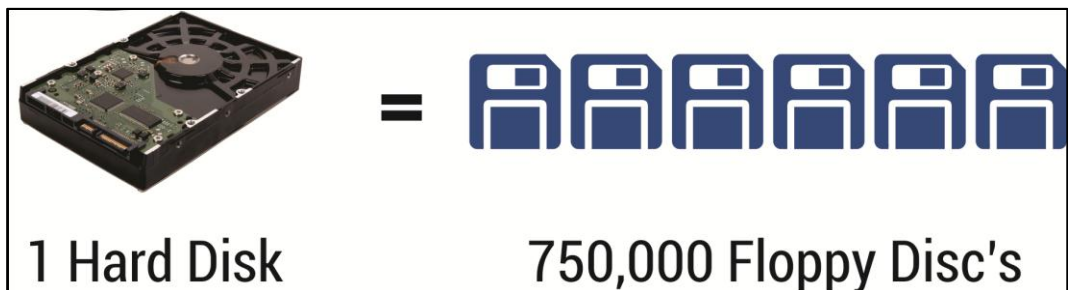Everything on the hard disk is organized into electronic paper known as files. These files store the information you write or design by its name. It is easy to locate files stored in the Hard disk, if you have saved the file with a file name. Just like memory, a hard disk also requires instructions to save your data. While saving your file, you need to tell the computer about the location where you want

your file to be placed on the hard disk. Hard Disk's save anything right from files, folders to images and pictures. Apart from saving anything on your hard drive, you can also delete any unwanted items from the Hard disk. Data on Hard disks can be stored permanently for longer duration of time.

Check your progress 2

1. To store data permanently, we use:-

   a. Hard disk   c. Floppy

   b. RAM   d. Pen drive

2. Which is not an example of Secondary Memory?

   a. RAM   c. Floppy

   b. Hard Disk   d. CD

1.4   Loading Program into Memory

It is the duty of the memory management to load the programs into the primary memory. This loading process is basically done to carry out the action by the processor or CPU. The principle idea of a virtual memory involves the use of Segmentation and Paging techniques. Partitions can be fixed or dynamic.

1.4.1   Fixed Partitioning

It is seen that an operating system will itself live in a fixed part of the main memory and leaves the balance space for different user/application processes. To analyse a main memory in fixed-sized partitions there exists two possibilities:

- Equal size partitions

- Unequal size partitions

Equal-size partitions

In case of a new process having the size less than or equal to the partitions' size it will directly be loaded in such a partition. Figure 1.4 shows Equal Partitioning in a Memory.

Fig. 1.7 Equal Partitioning in a Memory

There exist two problems with Equal sized partitions:

1.   The process requirements exceed the size of the partition.

2.   Small process occupies a full partition.

Unequal size partitions

In case of unequal size partitions, there exist two directions in order to allocate processes to partitions. The easy way to do this is to put each process to the smallest partition as per its size. Figure 1.7 shows unequal partitioning in a Memory.

```
┌─────────────────┐
│ Operating System│
│      512K       │
├─────────────────┤
│                 │
│      128K       │
│                 │
├─────────────────┤
│                 │
│      256K       │
│                 │
├─────────────────┤
│                 │
│      320K       │
│                 │
├─────────────────┤
│                 │
│      576K       │
│                 │
├─────────────────┤
│                 │
│      758K       │
│                 │
├─────────────────┤
│                 │
│       1M        │
│                 │
└─────────────────┘
```

Fig. 1.8 Unequal Partitioning in a Memory

For this, a scheduling queue is required for every partition in order to hold change out processes that is kept for that partition. With this, the processes are allocated in such a way that it will lower the exhaust memory inside the partition. Such process seems to be good for an individual and not for all.

1.4.2   Dynamic Partitioning

Dynamic partitioning takes care about some defects of fixed partitioning in which the partitions are of uneven length and number. In this, when a process begins, it will fill a partition of exactly the required size with no extra space. Figure 1.6 shows the arrangement of dynamic partitioning in a memory. There are various parts of this partitioning diagram.

In figure (a), it is seen that the primary memory is empty except for an operating system. The next three diagrams (b), (c) and (d) show that an operating system ends and occupies much space for each process. With this, a hole present at the end of a memory is too small for the next process. It is seen that during certain point, none of the processes in the memory is ready, so the operating

system changes out the second process as shown in diagram (e), which leaves enough space to load a new process as shown by diagram (f). From the diagrams it is seen that the fourth process is smaller than the second process that will result in the creation of another small hole. Now at a point where none of the processes in the main memory is ready but the second process is ready, then a hang up state will become available.
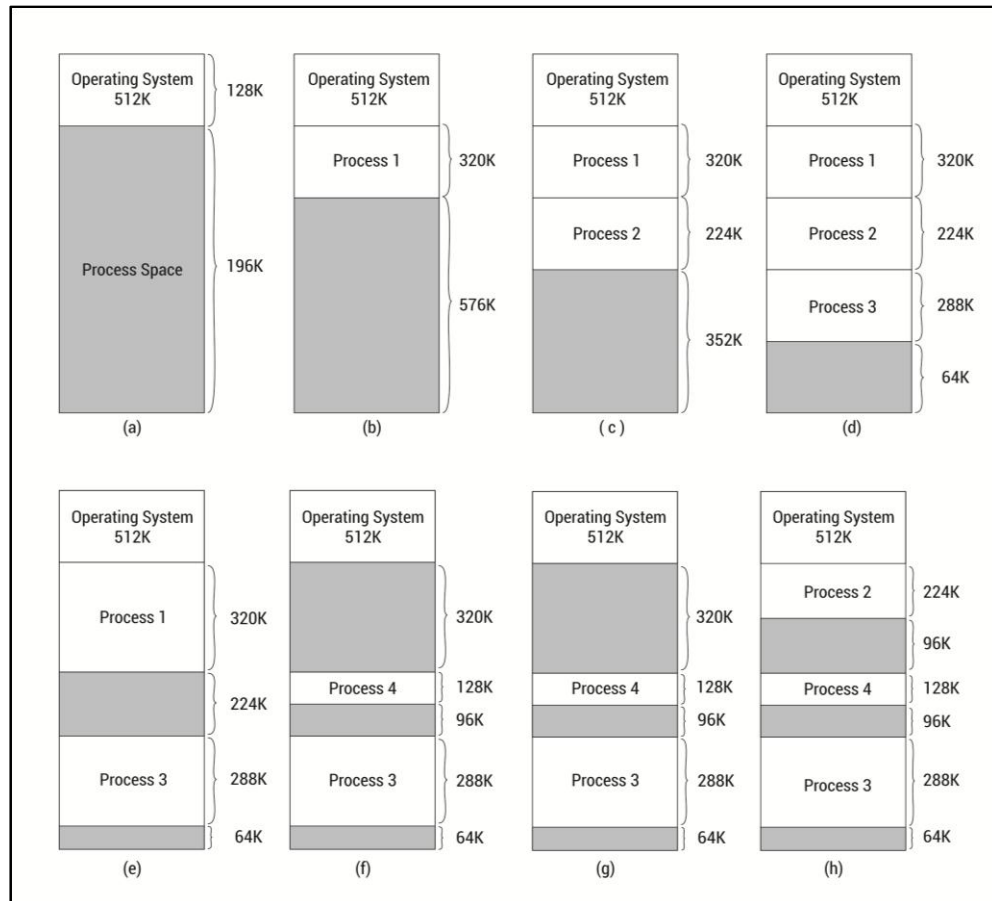
Figure 1.9 Arrangement of dynamic partitioning

Because of less space in the memory for the second process to be executed, the operating system hangs the first process out as shown in diagram (g) and changes the second process back as highlighted in diagram (h). It is seen that such methods will work out well, but finally it shows a situation where there are many small holes present in the memory. With the passage of time, the memory gets fragmented and declines.

Check your progress 3

1. Virtual memory involves the use of _____techniques:

   a. Segmentation   c. both

   b. Paging   d. none

2. In equal partition, the size of the process in all the partition remains:

   a. same   c. varies with number

   b. different   d. less than 1KB

3. Dynamic partition involves the use of _____ processes.

   a. one   c. three

   b. two   d. four

1.5   Loading and Storing Data to Hard Disk

Hard Disk is a storage media where the data or information is loaded and stored. This information could be software, data files, images etc. A user can access his stored or loaded information anytime. The hardware arrangement of a hard disk is shown in figure 1.7 where there are hardware parts such as Actuator, Read/Write Actuator arm, Spindle, Read/Write head and Platter. It is seen that the data sent or taken from the hard drive is normally done or is understood by the disk controller. The disc controller tells the hard drive what to do and how to move the components inside the drive. The figure 1.7 highlights certain features of the data that is transferred or looked by hardware components.
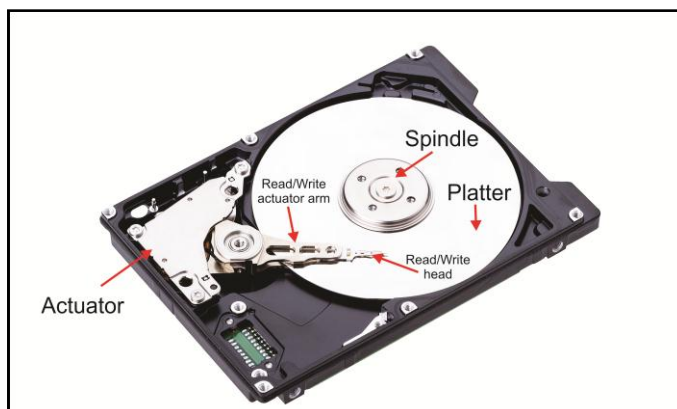

Fig. 1.10 Data reading arrangement in Hard Drive

If your hard disk is raw, you will first load an operating system. If any operating system needs to read or write its information, it first checks the hard drive for a File Allocation Table in order to decide about the file location and file place. After doing that, the disk controller directs the actuator to move read/write arm and arrange read/write head.
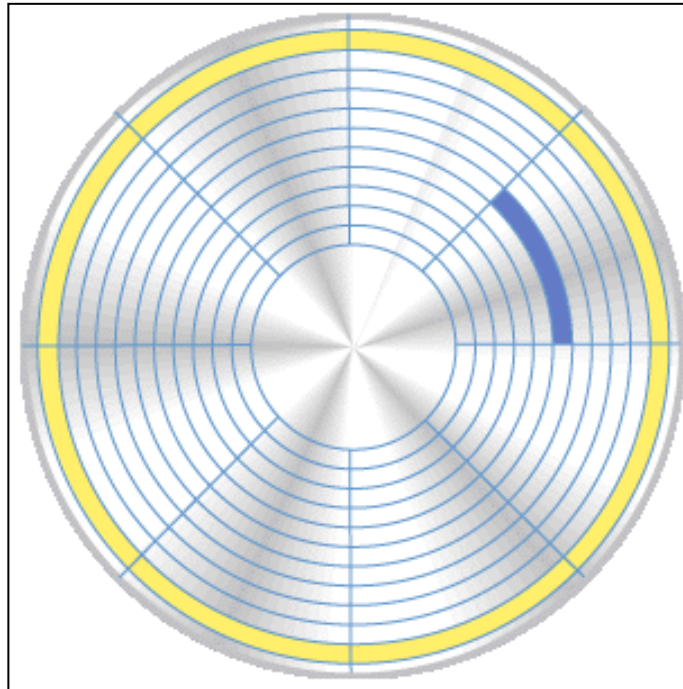
Fig. 1.11 Tracks and sectors on Hard Drive

It is observed that in the hard disk, the data is stored on the surface of a platter which is made up of aluminium, glass or ceramics that carries sectors and tracks as shown in figure 1.8. Each platter has two read/write head. We can see from the figure that tracks which are yellow in colour are concentric circles and sectors which are blue in colour are pie shaped wedges on a track. Further, a sector contains a standard number of bytes i.e. 256 or 512. During the loading of data the files spreads throughout the platter. Since files are scattered on the platter, the head tends to move to different areas in order to get all the relevant information.

Check your progress 4

1. Hard Disk is used to store:

   a. pictures   c. information

   b. data   d. all of these

2. Which is not a hardware part of the Hard Drive?

    a. spindle   c. ribbon

    b. actuator   d. platter

3. Hard Disk platter is made of:

    a. iron   c. zinc

    b. copper   d. aluminum

1.6 Let Us Sum Up

In this unit we have learned:

- Memory is made up of one or more chips which hold the data or information temporarily during the processing.

- Certain memories are volatile, such as RAM, in which the data gets lost when the power is switched off.

- In a non-volatile memory, such as ROM, the data remains permanently even when the power is switched off.

- Hard disk is a storage media which stores data, instructions and information for future use as it is nonvolatile.

- Data or information on the hard disk can be loaded for longer use and any unwanted information can be deleted anytime.

1.7 Answers for Check Your Progress

Check your progress 1

Answers: (1-a), (2-b)

Check your progress 2

Answers: (1-a), (2-b)

Answers: (1-c), (2-a), (3-a)

Answers: (1-d), (2-c), (3-d)

1.8 Glossary

1. **Bit -** It is the smallest unit of a computer memory.

2. **Byte -** A unit of memory storage that is equal to 8 bits.

3. **CPU -** It stands for Central Processing Unit and is also known as a processor.

4. **Hard Disk -** It is a type of storage media which is used to store data, programs and information permanently.

5. **MB -** megabyte, it is a unit of memory storage that is equal to 1,048,576 bytes.

6. **Primary memory -** It is the main memory that helps the processor to work.

7. **Processor -** It is a computer component that interprets all the instructions.

8. **RAM -** Random Access Memory it is the primary memory and is volatile.

9. **ROM -** Read Only Memory is non-volatile memory.

10. **Volatile memory -** Memory that requires power to maintain the stored information. If the power is turned off, the stored memory is lost.

1.9 Assignment

Prepare a report showing the internal structure of a Hard disk and label its parts.

1.10 Activities

Write the major steps of comparison between a memory and a hard disk drive.

1.11 Case Study

Highlight the important features among volatile and nonvolatile memory and compare it with practical presentations.

1.12 Further Readings

1.   The Indispensable PC Hardware Book. Addison-Wesley.

2.   Introduction to Direct Access Storage Devices, M. Bohl, IBM.

3.   Dandamudi, Sivarama P., Fundamentals of Computer Organization and Design, Springer.

4.   Goda, K., Kitsuregawa, M. The History of Storage Systems.

UNIT 2: LOGICAL ARCHITECTURE

Unit Structure

2.0   Learning Objectives

After learning this unit, you will be able to understand:

- About registers.

- About ALU and its features.

- The Internal Bus Structure architecture.

- The Read/Write Cycle of Memory.

- About Control Unit and Cache Memory.

2.1   Introduction

The Computer system works on a set of logical processes which is known as logical architecture. The architecture is a group of regulations that shows functionality, organization and implementation of computer systems. The Logical Architecture explains the different activities and functions that are required to give certain user services. These processes work in a group and share information to give user service. Such processes are carried out with the help of software, hardware or firmware.
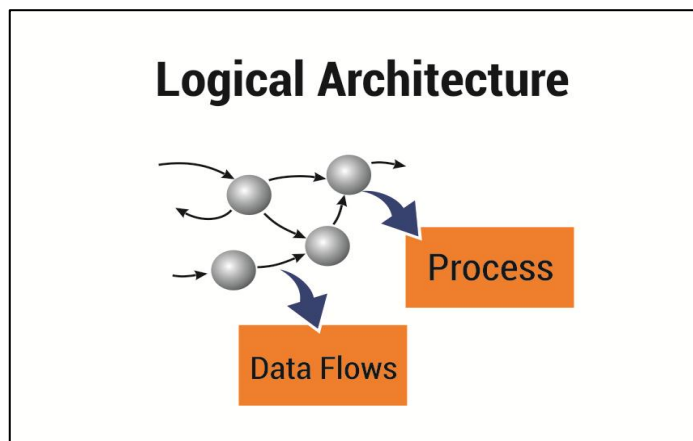
Fig. 2.1 Logical process of a Computer

Figure 2.1 gives us an idea about the logical process of a Computer system where different processes such as data flow; terminator and data storage takes place. Here data flows find the information that was shared by different processes. The basic entry and exit points for Logical Architecture comprises of sensors, computers and terminators. The basic logical structure of a computer is shown in figure 2.2.

Fig. 2.2 Logical Structure of Computer

It includes:

- **BIOS:** It is basic input output system which is responsible for the booting of a computer.

- **CPU:** It is a processor which is the brain of the computer that executes processes.

- **Memory / RAM:** It is used to store temporary data.

- **Hard Disk:** This is used for storing permanent information or data.

- **Input / output devices:** It gives input to a computer and derives the output from it.

- **Communication Channel:** It serves as an interface for external and internal devices.
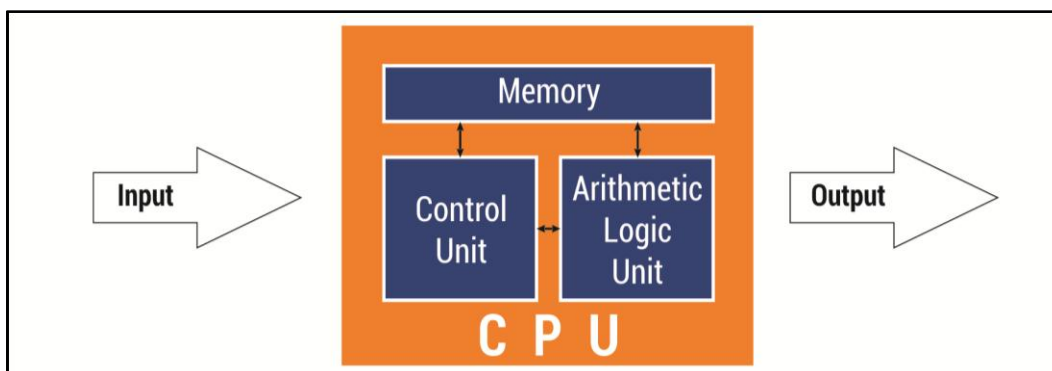
2.2   Registers

A register is an important part of a processor or a CPU having a separate memory location which helps in storing the temporary data and instructions. It is made of Flip flops. There are different types of registers:

1. **Memory Address Register (MAR):** Such register keeps the address of memory where the processor wants to read or write data.

2. **Memory Buffer Register (MBR):** This will hold the information of data or instruction that will be read from or written in the memory.

3. **I/O Address Register (I/O AR):** This register specifies the address of a particular I/O device.

4. **I/O Buffer Register (I/O I3R):** This Register exchanges the data among the I/O module and the processor.

5. **Program Counter (PC):** it is a register which is used to keep the address of the next instruction that is to be fetched for execution.

6. **Instruction Register (IR):** This register stores the fetched instruction from the main memory.

7. **Accumulator Register:** This register is placed inside the ALU and is used at the time of arithmetic & logical operations performed by the ALU.

8. **Stack Control Register:** This register manages the stacks in memory. Such type of register is of the size 2 or 4 bytes.

9. **Flag Register:** This register is used to show the occurrence of a certain condition at the time of operation of the processor. In this type of special purpose register with size being 1 byte or 2 bytes, each bit of the register forms a flag.

Check your progress 1

1. The computer architecture is a group of regulations that shows_____of computer systems.

    a. functionality   c. implementation

    b. organization   d. all

2. The basic logical structure of computer carries:

    a. memory   c. instructions

    b. uses   d. data

3. Registers are made of:

    a. RAM   c. Logic gates

    b. ROM   d. Flip flops

4. _____register is placed in ALU and is used at the time of logical operations.

    a. Instruction   c. Stack Control

    b. Accumulator   d. Flag

2.3 ALU

ALU means Arithmetic and Logic Unit. It performs arithmetic and logical operations on data and information. It is an electronic component in the computer which is based on the use of simple digital logic devices that can store binary digits and perform simple operations.
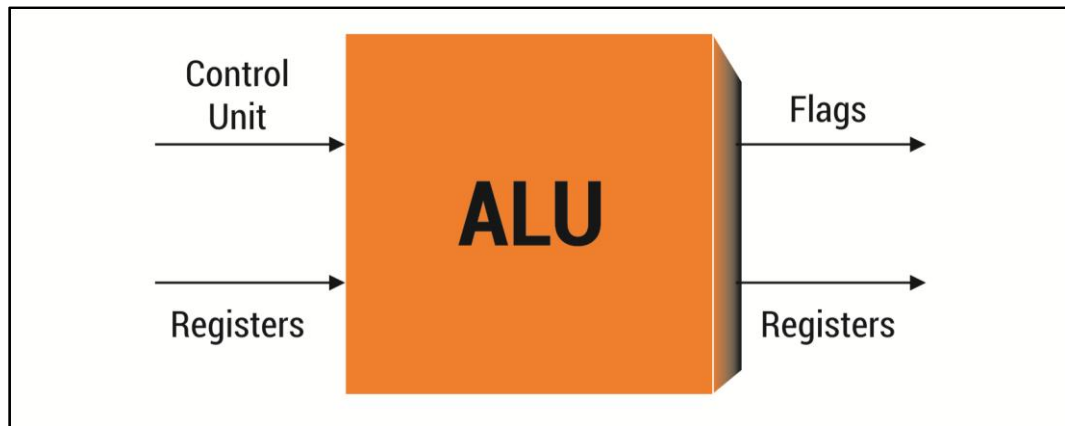
Fig. 2.3 Arrangement of ALU

Figure 2.3 shows the arrangement of ALU along with a processor. It is a major component of the CPU that enables arithmetic and logic operations to be done on instruction. It is divided into Arithmetic unit (AU) and Logic unit (LU). Data are presented to the ALU in registers whose results are stored in registers. The registers are temporary storage places inside the processor that is joined by the signal paths to the ALU. The ALU sets flags as the result of an operation. The arithmetic-logic section performs arithmetic operations, such as:

- Addition

- Subtraction

- Multiplication

- Division

Such operations of ALU can be described as:

- Logical Operations: It performs logical operations with Logic gates.

- Bit Shifting Operations: It performs movement of bits by certain places either right or left.

- Arithmetic Operations: It performs addition and subtraction of bits.

As shown in the figure 2.4, the arrows show the flow of data between the arithmetic logic unit and memory at the time of processing. Here the data is transferred from the memory to arithmetic logic section for processing.
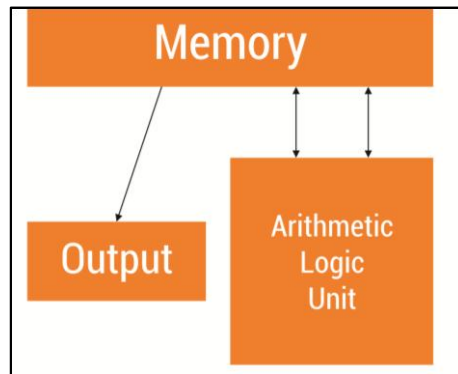
Fig. 2.4 Flow of Data between Arithmetic logic unit and Memory

It is seen that soon after processing, the data is returned back to the memory again. This data is transferred back and forth between these two sections continuously. The result so obtained is transferred from memory to the output device. If you see the binary addition and multiplication, you will find the grouping as:

0+0=0

0+1=1

1+1=10

1+0=1

0×0=0

0×1=0

1×1=1

1×0=0

From the above mathematical operation table, it is seen that if you ignore the carry, then subtraction of two single digit binary numbers will result in the same bit addition.

Check your progress 2

1. ALU stands for

   a. Arithmetic logic Unit   c. Arithmetic Local Unit

   b. Addition Logic unit   d. Addition Local unit

---

2. Which is not performed by ALU

   a. Addition   c. Multiplication

   b. Subtraction   d. Exponent

3. Which is correct logical operation

   a. 0+0=1   c. 1+1=2

   b. 0+1=0   d. 1+0=1

2.4   Internal Bus

In a computer system, a bus is a connection made between two or more than two devices. It is an internal circuitry of a processor that communicates with the internal caches of memory as a part of the CPU chip design. It is faster in operation and is independent of other computer operations. Figure 2.5 shows an arrangement of a bus structure inside a computer.
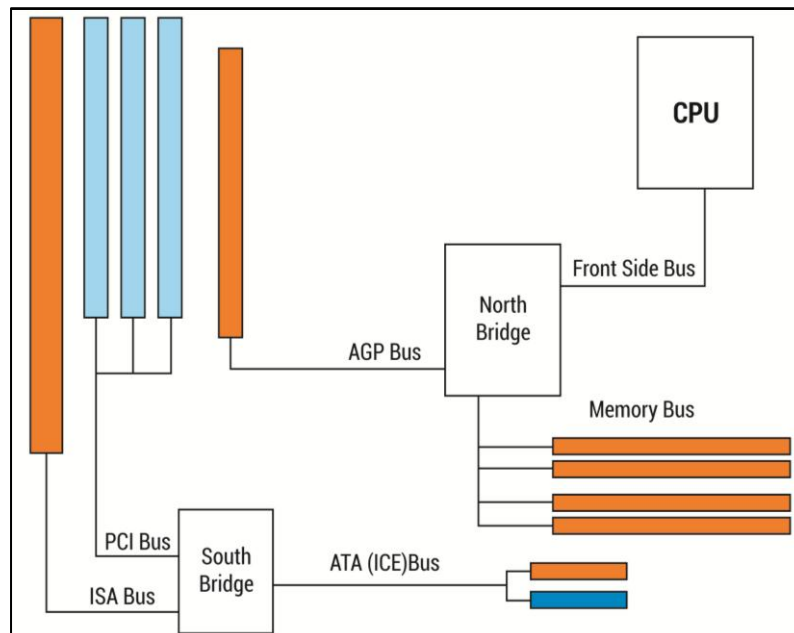

Fig. 2.5 Bus Structure of a Computer

Since a bus connects many devices, so it contains multiple wires which are basically signal lines having addressing information that explains about the memory location either to send or retrieved data. Every single wire carries a bit of

information. Today, normally all buses whether parallel or serial are utilized by computer systems. There are two types of Buses:

- Internal bus

- External bus

An internal bus makes a communication among internal components of a computer system such as video card and memory, whereas, an external bus communicates with external components of a computer system such as USB or SCSI device.

The internal bus is commonly known as system bus which comprises of four parts such as:

- **Power bus:** It has wires which gives power to every part of the main board.

- **Control bus:** It sends the timing signals out to make the other components to stay on the main board at a time with the processor.

- **Address bus:** It sends the information on memory addressing that will tell the parts installed on the main board about the instructions and data in memory.

- **Data bus:** It transmits the real data among the system components.

Check your progress 3

1. In a computer system, _____ is a connection made between two or more than two devices.

   a. bus   c. rod

   b. line   d. plate

2. External bus can communicate with:

   a. memory   c. audio card

   b. video card   d. USB device

3. _____bus transmits the real data among the system components.

   a. Power   c. Address

   b. Control   d. Data

2.5   Read/Write Cycle of Memory

Primary memory is a read/write memory in which the data reads or writes. Such process of reading and writing of data is called as memory cycle. Such type of cycle allows reading of data out of memory and writing of data into the memory. This is done with the help of the read/write operation or separate read and write operations. It is examined that a memory cycle depends on the fixed time periods for reading and writing of data from the memory or into the memory. After the execution of read and/or write operations, there exists an address translation which makes the read and/or write cycle or practically such an operation starts with a memory cycle.

It is seen that before the beginning of a read or write cycle, there exists an important process known as memory address translation. In the memory, series of memory locations begins with address 0 and extends up to the highest memory address that is made available with the requester i.e. CPU or I/O. This process is same as the process that involves sending and receiving of e-mails. Before sending a mail, a user should have a mail address where the mail is to be delivered or sent. Just like that, memory also obeys a similar principle. Memory logic recognizes a memory address where the memory word is read from or written into. Therefore, a memory address could be anything from the memory addresses (0 to maximum). To locate the required memory address, memory logic uses a register which can form address registers or translators or decoders. Practically, memory logic gets the logical address either from the processor or from the I/O which temporarily stores it in the address register. The stored information then gets converted into a physical address which can be read from or written into.

In this, the address register or a translator finds the correct place from where it can read or write the bits. The data or information contained in the address register or translator identifies the correct memory address. Further, the memory logic is designed to have its selection done on the basis of type of memory it utilises. Also, memory cycle is designed to find a memory address of a single memory PCB or to find an address placed in one of four memory locations.

Check your progress 4

1. To locate the required memory address, memory logic uses:

   a. buses   c. cpu

   b. register   d. memory

2.6   Control Unit

The control unit is an important part of central processing unit as it directs the flow of operations and data. It maintains the order of operations inside the computer.
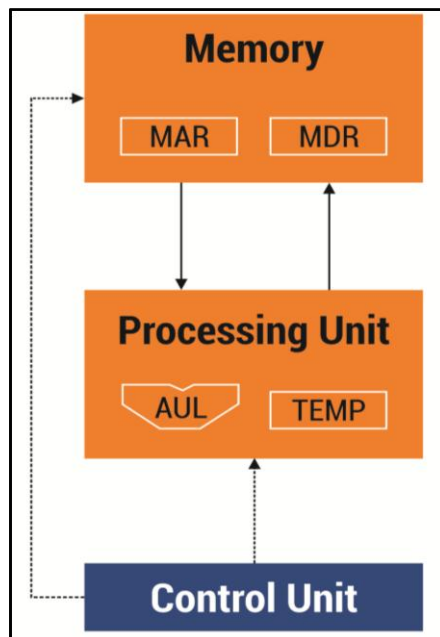

Fig 2.6 Arrangement of Control Unit

In figure 2.6, memory, processing unit and control unit displays a block of operations. The flow of control is shown by dotted lines. The control section selects the program statement from the program storage area and after understanding the desired statement sends it to the arithmetic logic unit and memory unit to carry out the required instructions.

It is examined that a control section does not perform any actual processing operations on the required information or data. The Control unit simply instructs the input device regarding the start and stop of transferring of data to the input storage area. Further the Control unit instructs the output device when to start and stop receiving of data from output storage area.

2.7   Cache Memory

Cache memory is the CPU memory which is commonly known as Random Access Memory (RAM) is such type of memory that can be easily accessed by a microprocessor. Such type of memory is directly placed around the microprocessor chip as shown in the figure 2.7.

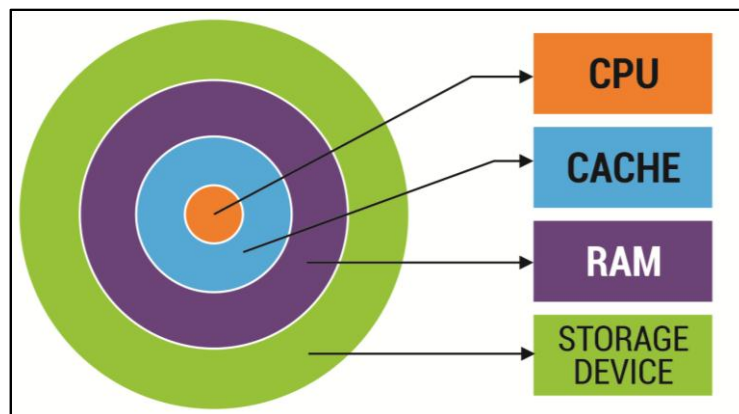**Fig. 2.7 Position of Cache Memory**

Figure 2.7 shows the arrangement of cache memory. The main function of the cache memory is to store program instructions that are frequently arranged by software at the time of operation. By accessing such instructions, the speed of the software programs gets increased. After the data is processed by the microprocessor, it first sends it to the cache memory.

2.8   Let Us Sum Up

In this unit, we have learned:

ALU stands for Arithmetic and Logic Unit which performs Addition, Subtraction, Multiplication and Division. It is found that data paths are internal registers which can be arithmetic as well as logical part that carries the desired bus structures.

Memory in Computer architecture is the main or primary memory which is a collection of cells or locations. It is found that control unit is the main part of the computer architecture which controls the progress of other parts.

Cache memory is the CPU memory which is commonly known as Random Access Memory is such type of memory that can be easily accessed by a microprocessor.

2.9   Answers for Check Your Progress

Check your progress 1

Answers: (1-d), (2-b)

Check your progress 2

Answers: (1-a), (2-d), (3-d)

Check your progress 3

Answers: (1-a), (2-d), (3-d)

Check your progress 4

Answers: (1-b)

Check your progress 5

Answers: (1-c)

Check your progress 6

Answers: (1-c)

2.10 Glossary

1. **ALU -** It is Arithmetic and Logic Unit that performs ADD, SUBTRACT, AND, OR, and NOT operations.

2. **Data path -** These are internal registers, ALU and its connecting buses.

3. **Memory -** It is a collection of cells or locations.

4. **Control Unit -** It is a control tower in the computer architecture that checks the progress of other parts.

2.11 Assignment

Prepare a report and write the various features about the logical architecture of a Computer.

2.12 Activities

Design an internal architecture model of a processor and discuss it.

2.13 Case Study

Visit to a Computer Hardware Store and enquire about the location of cache memory.

2.14 Further Readings

1. Linda Null; Julia Lobur. Essentials of Computer Organization and Architecture

2. C. Gordon Bell; R. Cady; A New Architecture for Mini-Computers

UNIT 3: PROGRAM EXECUTION

Unit Structure

3.0   Learning Objectives

After learning this unit, you will be able to understand:

- About execution of programs.

- Fetch Decode Execution Cycle.

- About buffering.

3.1 Introduction

In Computer architecture, a program is a set of instructions that the Computer system will follow. A computer is designed to work on the instructions that are written by the programmer in a simple language known as machine language. This type of language is only understood by the computer system. Different computers have their own set of instructions written in a specific machine language which can help to execute a program directly. If the instructions are written in any other language, then such instructions will not be understood by the computer as it is only familiar with the Machine Language.

When a process or performs a certain program, then the output of the program is stored in the computer's main memory which is known as RAM or Random Access Memory. Apart from the program, the computer memory also keeps the data that is being used or developed by the program. There exists a sequence of locations inside the main memory. Such locations are marked with numbers and the sequence number of a location is termed as its address. To show or display any information, the address will pick out a piece of information from the memory where they it is kept. If the CPU wants to work on the program instructions or data in a specific location, it sends the address of that information by way of a signal to the memory. With this the memory sends back the data contained in that location. The processor stores the information in the memory by identifying the information and the address of the location where it is to be stored.

3.2 Execution of a Program

As described, a program is a set of instructions written in the machine language. A computer executes machine language programs as it is easily followed and further manipulates and reads machine language codes as these codes are directly understood by it. It is seen that a computer is a machine which is designed and built by tiny switches known as transistors. These switches have a unique property of getting connected together in such a way that the outputs from one switch will able to make another switch on or off. As the computer starts working, these switches will make each other on or off in the way they are connected and programmed.

Machine level language instructions are binary numbers 0 or 1. In this, each 0 or 1 is known as a bit. It follows that a machine language instruction is a series

of zeros and ones. Every series of sequence will result in a particular instruction. The data that the computer understands and controls is also transformed as binary numbers 0 or 1. Presently, in every computer, each memory location keeps a byte, which is a sequence of 8 bits.

It is seen that a computer can work directly with binary numbers 0 or 1as switches can easily show these numbers. It means, to turn the switch ON, it is 1, while to turn the switch OFF, it is 0. Hence machine language instructions are kept in the memory as an arrangement of switches which gets turned ON or OFF. When a machine language instruction is kept into the CPU, then some switches get turned ON or OFF in the sequence that encodes such instructions. The processor is designed as such that it should respond to such an arrangement by executing the instruction it encodes.

It is the duty of the main memory to hold the machine language programs and data. Such programs and data are encoded as binary numbers 0or 1. The CPU gets the machine language instructions from the memory one by one and executes them. This execution of instructions is mechanical, as the processor is manipulating it without thinking or understanding. The program it executes must be perfect, complete and clear-cut as the processor can do nothing more but easily execute what is written. The figure 3.1 shows the movement of information from the processor to the memory.
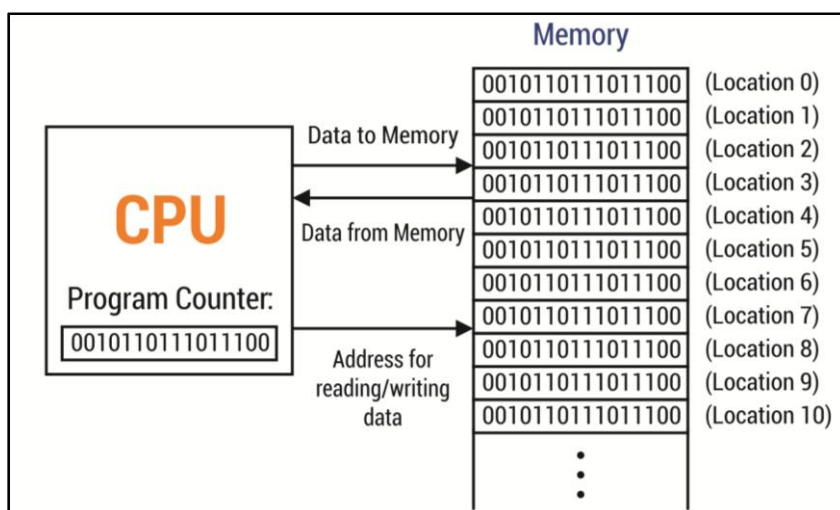

Fig. 3.1 Data movement inside Computer

With the view of machine language, the operation of the processor is clear. It executes a program that is stored as a sequence of machine language instructions in the main memory. The work of the program execution is done by the processor by frequently reading or fetching up of instructions from the

35

memory and then carries out or executes such instructions. This type of process off etching an instruction and executing it and then further fetching another instruction and further executing it is known as fetch-and-execute cycle.

Check your progress 1

1. The minimum memory address from 0 to 256 is:

   a. 1   c. 255

   b. 0   d. 256

2. Which is a binary number, in terms of machine instructions?

   a. 1   c. 3

   b. 2   d. 7

3. Fetch-and-execute cycle is performed by the:

   a. memory   c. hard disk

   b. processor   d. USB drives

3.3 Fetch-Execute Cycle

It is a sequence of actions that are performed by the processor or central processing unit in order to execute the machine code instructions in a program. Initially, the processor shows the value of a program counter on the address bus. After that the processor fetches the instructions from the main memory through cache or pipeline data bus into the instruction register. Once the information is there in the instruction register, the data that forms the instruction is decoded and sent to the control unit which transmits a series of control signals to the processors requisite function units so as to enact the actions by the instruction, like:

- Reading values through the registers.

- Further transmitting these values to the ALU.

- Adding the values together and writing the result back to the register.

The address is passed on by the program counter to the next instruction which leads to the continuation of a cycle. The features of Fetch and interrupt are:

Fetch

- Program Counter (PC) contains the address of the next instruction to be fetched.

- Address in the program counter gets copied to the Memory Address Register (MAR).

- Instruction is copied from the memory location in MAR and is transferred to Memory Buffer Register (MBR).

- Instruction is copied from the MBR is placed in Current Instruction Register (CIR).

- Program Counter is incremented for the next instruction to be fetched.

Execute

- Address part of the instruction is placed in the MAR.

- Instructions are decoded and executed.

- Processor checks for interrupts.

The fetch execute cycle was initially invented by John von Neumann.

Check your progress 2

1. Fetch-and-execute cycle was invented by:

   a. Pascalline   c. Abacus

   b. John von Neumann   d. None of the above

3.4 Fetch-Decode-Execute Cycle

It is clear that a CPU will understand and perform instructions written only in the machine language. While doing so, both the inputs to the CPU are stored in the main memory. Now to function, the CPU requires a cycle that will fetch the instruction, decode the instructions and execute such instructions. This process is commonly known as fetch decode execute cycle.
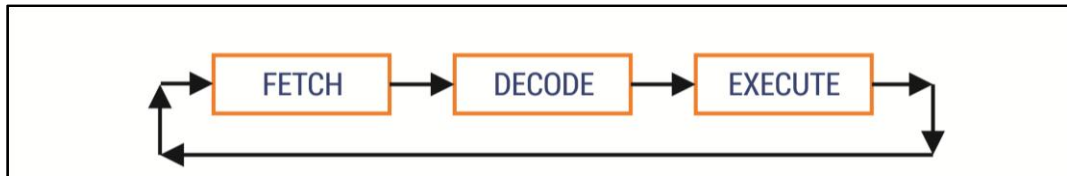
Fig. 3.2 Fetch decode execute cycle

The Fetch decode execute cycle as shown in figure 3.2 begins when an instruction which is sent from the memory to the Instruction Register along the data bus. The Instruction Register carries a special bit of patterns that enables the machine language to take out and send the instructions back to the Decoder. Further, during the next part of the cycle, the processor recognises the part of bit pattern that performs the correct operation. The operations of a Fetch decode execute cycle involves:

• Reading data from the memory.

• Storing data in the memory.

• Activating ALU to do mathematical operations.

After the operation, the cycle begins again with the next instruction as it is the work of the processor to find the next instruction. In this, the Program Counter holds the address of the current instruction. Every time when an instruction gets completed, the program counter will move ahead by one memory location.

Check your progress 3

1. Fetch-and-execute cycle is performed by the:-

   a. memory   c. hard disk

   b. processor   d. USB drives

2. Instruction copied from Memory Buffer Register is kept in

   a. Memory Address Register   c. Current Instruction Register

   b. Program Counter   d. Memory Buffer Register

3. In Fetch decode execute cycle, an instruction is send from

   a. memory to Instruction Register   c. memory to Program Counter

   b. memory to Current Instruction Register   d. memory to Buffer Register

3.5 Program Execution with Fetch-Decode-Execute Cycle

To execute a program, the first step what the CPU does is to carry some data and instructions from the main memory which he stores into its own internal temporary memory location. To fetch the instruction, the address bus on which the address is placed for the next item to be fetched on the address bus is used by the CPU. In this, the address is moved from the main memory to the CPU by covering the data buses. Consider the figure 3.3 where a processor is ready to carry out the instruction. In this the instruction pointer has address 0100 which shows the instruction MOV AX, 0. The instruction is kept on the data bus by the memory. The instruction from the data bus is then copied by the CPU to the instruction register.
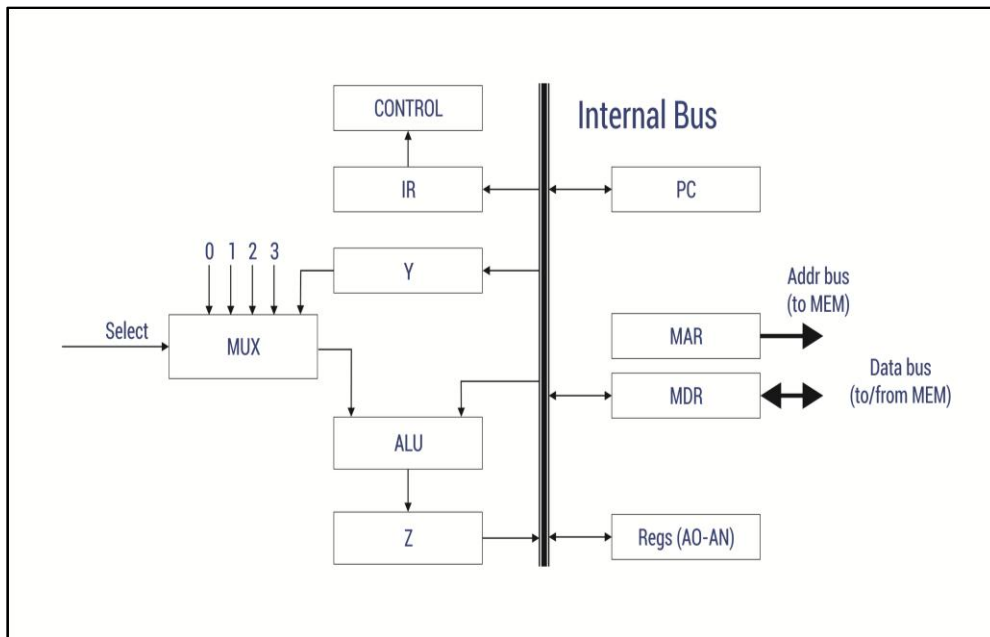

Fig. 3.3 Fetching of Instructions

he CPU then senses the fetched instruction to further decode it. For this, if needed, the processor can obtain an operand by the instruction. The instruction MOV AX 0. Stores the value 0 in A x location as seen in the figure above. Now, before the execution of the instruction the processor carries the fixed value 0 from the next memory location. In figure 3.3, the instruction from the instruction register is sent by the CPU or processor to the decoder. The instruction instructs the computer to store 0 in AX register. After decoding, the decode unit keeps all the details of the process.
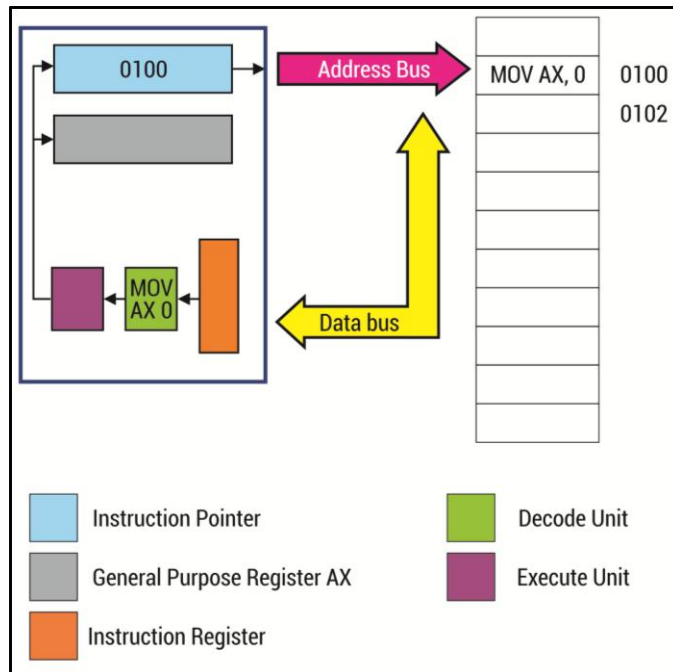
Fig. 3.4 Decoding Instructions

Finally, the CPU will execute the instruction 0 what is stored in register AX. In figure 3.5, the processor starts executing the MOV AX, 0 instructions. Then, the CPU will adjust the instruction pointer to point to the next instruction which needs to be executed that is kept at address 0102 location.
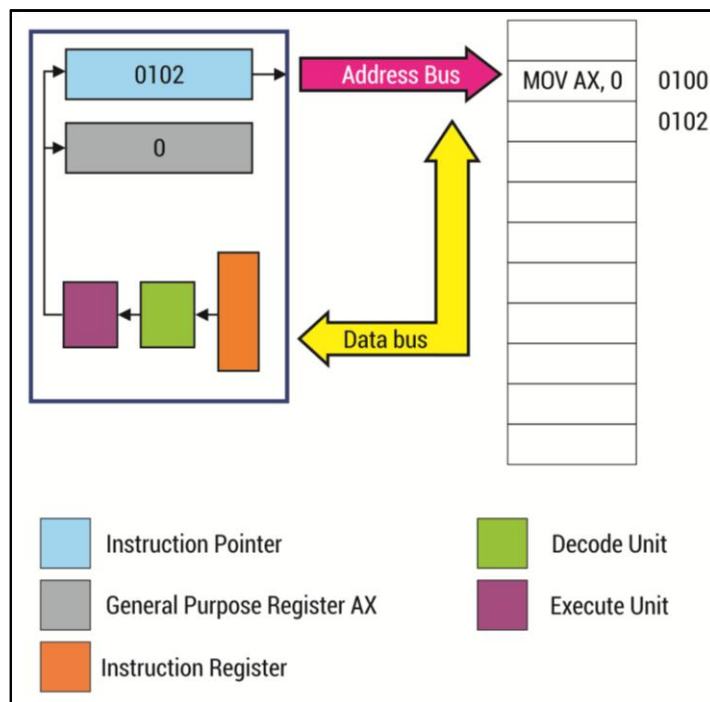

Fig. 3.5 Executions of Instructions

Check your progress 4

1. To fetch an instruction, a CPU uses:

    a. data bus

    b. address bus

    c. control bus

    d. instruction bus

2. MOV AX, 0. is refer to as

    a. data

    b. information

    c. instructions

    d. register

3.6   Buffering Concept

Buffering is a term which is used in Computer hardware and programming which means screening of the processed data from its final place so that it can again be processed before being transferred to the database.

There are different kinds of buffering strategies:

*   Characters which are written to or read from an un buffered location that are moved alone.

*   Characters which are written to line buffered location that are moved to file when newline characters appear.

*   Characters which are written to or read from the buffered location are moved to or from the file of any size.

Check your progress 5

1. Buffering means:

    a. saving of processed data

    b. screening of processed data

    c. deleting of processed data

    d. mixing of processed data

3.7   Let Us Sum Up

In this unit, we have learned:

- The Computer understands the Machine language.

- The instructions are in the form of binary numbers 0 and 1.

- The processor processes the information by the way of a fetch execute cycle.

- In fetch decode and execute cycle, the instructions are fetched, then decoded and finally executed by the processor.

- Buffering is the checking of processed data from its location for execution before delivering it to the final database.

3.8   Answers for Check Your Progress

Check your progress 1

Answers: (1-b), (2-a), (3-b)

Check your progress 2

Answers: (1-b)

Check your progress 3

Answers: (1-b), (2-b), (3-a)

Check your progress 4

Answers: (1-b), (2-c)

Check your progress 5

Answers: (1-b)

3.9 Glossary

1. **Addresses -** memory addresses show the location of the instruction in the ALU.

2. **Registers -** Are to keep data such as floating point numbers or addresses.

3. **Instructions -** These are machine instructions with the size same as an architecture's word.

3.10 Assignment

Give reasons why some processors can work faster than the other.

3.11 Activities

Write steps about how a CPU executes a set of instructions.

3.12 Case Study

Locate what a processor does at the end of a fetch decode execute cycle.

3.13 Further Readings

1. Computer Organization by Goldberg

2. Computer Architecture by Sarah Harris

3. Computer Mainframes by Almasi and Gottlieb

Block Summary

In this block of Logical Architecture of a Computer, we have learned and summarized the main hardware with which a Computer processes the instructions.

Unit 1 of our block explains about the Memory and Processor. In this we have given an idea about what a processor is and its functional features. We explained the different hardware's for data storage and data manipulations.

This unit also explains about the role of a hard drive in accessing and keeping the data for longer use.

Unit 2 of this block explains the logical architecture of a computer system. It describes the necessary hardware used for data calculation, transmission and manipulation. This unit tells us about Registers, ALU, Internal Bus, Read/Write Cycle of Memory, Internal Bus, Control Unit, Cache Memory, etc.

Unit 3 of our block is an output of all the hardware's what we come across in unit 1 and 2. This unit explains the working of each hardware in shaping a computer program. . We see that once the hardware is ready, now it's time to use it by the way it understands. So this unit stresses on the execution, decoding and carrying out the information a computer system understands. It explains how a program is executed.

Block Assignment

Short Answer Questions

1. What is a Computer Memory?

2. What is Buffering?

3. What are registers?

4. What do you mean by Program Counter?

5. What is the function of ALU?

Long Answer Questions

1. What is the role of CPU in Computer architecture?

2. How is Data written on a Hard Drive?

3. How are registers different from Program Counters?

Enrolment No. [   ]

1.   How many hours did you need for studying the units?

Unit No	1	2	3	4
Nos of Hrs				

2.   Please give your reactions to the following items based on your reading of the block:

Items	Excellent	Very Good	Good	Poor	Give specific example if any
Presentation Quality	☐	☐	☐	☐	_____
Language and Style	☐	☐	☐	☐	_____
Illustration used (Diagram, tables etc)	☐	☐	☐	☐	_____
Conceptual Clarity	☐	☐	☐	☐	_____
Check your progress Quest	☐	☐	☐	☐	_____
Feed back to CYP Question	☐	☐	☐	☐	_____

3.   Any Other Comments

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> *Education is something which ought to be brought within the reach of every one.*

- Dr. B. R. Ambedkar

Dr. Babasaheb Ambedkar Open University
Jyotirmay' Parisar, Opp. Shri Balaji Temple, Sarkhej-Gandhinagar Highway, Chharodi, Ahmedabad-382 481.

ARCHITECTURE OF COMPUTERS

BLOCK 2:
PHYSICAL ARCHITECTURE
OF COMPUTER/LAPTOP
AND SMARTPHONE

Dr. Babasaheb Ambedkar Open University
Ahmedabad

ARCHITECTURE OF COMPUTER

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ROLE OF SELF INSTRUCTIONAL MATERIAL IN DISTANCE LEARNING

The need to plan effective instruction is imperative for a successful distance teaching repertoire. This is due to the fact that the instructional designer, the tutor, the author (s) and the student are often separated by distance and may never meet in person. This is an increasingly common scenario in distance education instruction. As much as possible, teaching by distance should stimulate the student's intellectual involvement and contain all the necessary learning instructional activities that are capable of guiding the student through the course objectives. Therefore, the course / self-instructional material are completely equipped with everything that the syllabus prescribes.

To ensure effective instruction, a number of instructional design ideas are used and these help students to acquire knowledge, intellectual skills, motor skills and necessary attitudinal changes. In this respect, students' assessment and course evaluation are incorporated in the text.

The nature of instructional activities used in distance education self-instructional materials depends on the domain of learning that they reinforce in the text, that is, the cognitive, psychomotor and affective. These are further interpreted in the acquisition of knowledge, intellectual skills and motor skills. Students may be encouraged to gain, apply and communicate (orally or in writing) the knowledge acquired. Intellectual-skills objectives may be met by designing instructions that make use of students' prior knowledge and experiences in the discourse as the foundation on which newly acquired knowledge is built.

The provision of exercises in the form of assignments, projects and tutorial feedback is necessary. Instructional activities that teach motor skills need to be graphically demonstrated and the correct practices provided during tutorials. Instructional activities for inculcating change in attitude and behavior should create interest and demonstrate need and benefits gained by adopting the required change. Information on the adoption and procedures for practice of new attitudes may then be introduced.

Teaching and learning at a distance eliminates interactive communication cues, such as pauses, intonation and gestures, associated with the face-to-face method of teaching. This is particularly so with the exclusive use of print media. Instructional activities built into the instructional repertoire provide this missing interaction between the student and the teacher. Therefore, the use of instructional activities to affect better distance teaching is not optional, but mandatory.

Our team of successful writers and authors has tried to reduce this.

Divide and to bring this Self Instructional Material as the best teaching and communication tool. Instructional activities are varied in order to assess the different facets of the domains of learning.

Distance education teaching repertoire involves extensive use of self-instructional materials, be they print or otherwise. These materials are designed to achieve certain pre-determined learning outcomes, namely goals and objectives that are contained in an instructional plan. Since the teaching process is affected over a distance, there is need to ensure that students actively participate in their learning by performing specific tasks that help them to understand the relevant concepts. Therefore, a set of exercises is built into the teaching repertoire in order to link what students and tutors do in the framework of the course outline. These could be in the form of students' assignments, a research project or a science practical exercise. Examples of instructional activities in distance education are too numerous to list. Instructional activities, when used in this context, help to motivate students, guide and measure students' performance (continuous assessment)

PREFACE

We have put in lots of hard work to make this book as user-friendly as possible, but we have not sacrificed quality. Experts were involved in preparing the materials. However, concepts are explained in easy language for you. We have included may tables and examples for easy understanding.

We sincerely hope this book will help you in every way you expect.

All the best for your studies from our team!

ARCHITECTURE OF COMPUTER

Contents

BLOCK 3:   DEVICES FOR DISPLAY, INPUT AND POINTING

UNIT 1   DISPLAY DEVICES

LCD and LED monitors (for PC)

UNIT 2   INPUT AND POINTING DEVICES

Keyboard and mouse (for PC and Laptop), touch pad (for laptop), touch screen (for Mobile) – basic principle of each device and its interface with computer

BLOCK 4:   DEVICES FOR NETWORKING, I/O AND EXTERNAL STORAGE

UNIT 1   NETWORKING DEVICES

Modem, Wireless Modem etc.

UNIT 2   I/O AND EXTERNAL STORAGE

Pen Drive, Camera, Hard Disk, Optical Storage (CD/DVD),

Drives for CD/DVD, Inkjet Printers and laser printers

ARCHITECTURE OF COMPUTER

BLOCK 2: PHYSICAL ARCHITECTURE OF COMPUTER/LAPTOP AND SMARTPHONE

BLOCK 2: PHYSICAL ARCHITECTURE OF COMPUTER/LAPTOP AND SMARTPHONE

Block Introduction

Architecture is an arrangement of hardware inside a particular device. The architecture includes Buses, Data Cables, Connectors and related arrangements which connect through the main board. Memory is a part of a computer system that temporarily stores information that is required by the processor or CPU. Since CPU cannot do any job without a memory so memory contains small flat boxes of chips which are same as CPU chips containing memory devices instead of CPU circuits. Thus, memory is that part of a Computer system that remembers things for the CPU.

This block will introduces us to physical architecture of a Computer, Smartphone and a Laptop. In this, the user will be given more knowledge about the internal setting of hardware components with respect to their functions and working. The information regarding the Memory chip and Cache memory is explained. This unit also explains the role of a hard drive in accessing and keeping the data for longer use.

After completing this block, students will learn more about internal architecture of computer and smartphones with the knowledge related to memory storage. This will help students to make themselves work on smartphone technology and further helps in integrating specific features.

Block Objective

After learning this block, you will be able to understand:

- About memory chips and its features

- The basic of Cache Memory

- About the different configuration of Motherboard

- About Smartphone and its Hardware Components

Block Structure

UNIT 1: MEMORY CHIP AND CACHE MEMORY

Unit Structure

1.0   Learning Objectives

After learning this unit, you will be able to understand:

- About Computer Processor.

- About Memory Organization.

- About Cache memory.

- About Memory Chips.

1.1   Introduction

In this unit, we will learn the basics of a Computer Processor and how it works. It was stated earlier that computers do not understand high level languages, thus processors exist as only they are able to judge the instructions encoded in binary form. In order to execute a program, a computer processor gets the instruction from the computer memory and tries to execute it. In mainframes and supercomputers, the different functions performed by the processor expand from an individual chip to multiple circuit boards, where as in a personal computer, the functions of the processor are normally on a single chip. Computer memory is similar to our brain as it stores the data and instruction. It is located inside the computer and is placed on the motherboard.

1.2   Processor

A processor, also known as Central Processing Unit (CPU), is the brain of a Computer which understands and performs many basic instructions that helps in operating a Computer system. The first processor was invented by Intel in 1971 which is a 4 Bit device having a speed of 108 KHz. A Processor contains thousands or millions of small switches known as transistors. A processor impacts the total computing power and performs most of the computer's operation. All computers, large and small, must have a processor or central processing unit.

Fig. 1.1 Layout of Processor

Fig. 1.1 shows the layout of a processor (CPU). Its main part includes:

- Arithmetic logic unit (ALU)

- Registers

- Control unit

Memory Chip and Cache Memory

We see that the ALU is termed as Arithmetic logic unit which performs arithmetic and logic operations. The registers store the bits of information supplied to the object on which the operations are to be performed and pass it to the ALU and further keep the result of ALU operations. The control unit gets the instructions from the memory and perform the operations by directing the matched operations of the ALU registers and other components.

A processor operates with a speed of an internal clock when a current is applied. The main function of a processor is to carry out a series of stored instructions which are known as programs. A processor performs certain instructions based on certain basic operations which are kept in the main memory of a Computer system. For every instruction, the processor uses the following set of basic operations which is known as machine cycle.

1. Fetches the instruction or data from memory.

2. Decodes the instructions into commands as understood by the computer.

3. Executes the commands.

4. Stores the result in the memory.

Advantages

1. It performs fast calculation of mathematical data.

2. It controls the con Figuration of tiny switches known as transistors.

3. It controls the overall working of peripherals.

Check your progress 1

1. The first processor was invented by_____

   a. Intel   c. Apple

   b. Microsoft   d. Unix

2. Which is not a part of processor?

   a. Arithmetic logic unit (ALU)   c. Registers

   b. Memory   d. Control unit

1.3 Memory chip

Memory chip is an integrated circuit which is made of millions of transistors and capacitors. Memory chips can hold the permanent or temporary memory e by RAM or ROM. It stores the operating system, application programs and processed data. While working, a CPU needs both: information to be manipulated and instructions that tell the CPU to perform an action on that particular information, the memory holds these things and provides it to the CPU whenever CPU asks for it. It is seen that everything stored in the memory goes off when you switch off the computer system. The memory is divided into several small memory parts such as cells. Each cell has a different address which varies from 0 to 1.

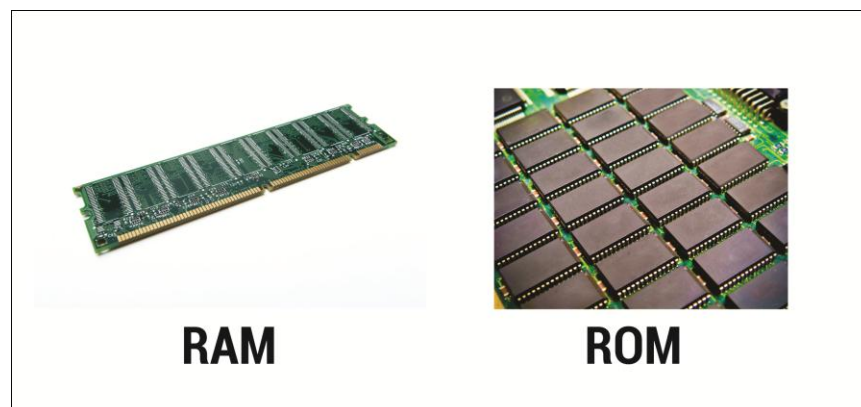**Types of Common Memory Chips**

- RAM

- ROM

Fig.1.2 Types of memory chips

RAM and ROM are primary memory, which is the main memory of the Computer. Such memory keeps that part of the data and instructions on which the computer is currently working. It has less capacity. It is volatile memory in which the data gets erased when the power is switch off.

RAM – It is known as Random Access Memory. It is the main working memory that is used by a computer. RAM is a common computer chip that stores vigorous data transiently in order to improve the efficiency of a computer. It enables the computer to access the data more quickly by storing the used or active files in memory. RAM is also used in printers and various other devices.

Unlike the non- volatile forms which include hard disks and flash memory which can retain data regardless of power, such memory is fickle since data is lost once the computer is turned off. The data from the RAM is transferred to the hard drive or flash drive once the computer has been shut down accurately.

Architecture and speed are the basis for classification of random access memory. In order to cope up with compatible motherboards RAM chips have increased speed and use new standards. A motherboard supports certain types of RAM along with limitations as to the amount of RAM supported.

Advantages

1.   It's a volatile memory.

2.   Fast data access.

3.   It can read and write.

4.   Stores dynamic data.

5.   Improves computer performance.

6.   RAM is categorized by architecture and speed.

Disadvantages

1.   Stores information temporarily.

2.   Should be compatible with the motherboard.

ROM – It is known as Read Only Memory. It is a special type of memory that keeps the software that can only be read but cannot be written. ROM is an integrated memory chip that contains configuration data. Its programming is fully fixed into the ROM chip. So ROM is considered as hardware as well as software.

A ROM is a non-volatile memory as data stored in it will not be lost when power is switched off. This type of memory helps to store the data needed to start up the computer. As ROMs are slower than RAMs, the instructions given in the ROM are sometimes copied to the RAM at start-up. It is one of the main types of memory that is used in PCs. Characteristics:

- Such type of memory is a semiconductor memory.

- It is the main memory of a computer.

- It is not stable.

- In this, the data does not get erased when power is switch off.

- It is the working memory of a computer.

- It is slower than RAM.

- Without such memory, the computer system cannot work.

Uses

1. ROM is used in all computers.

2. Stores system level programs.

3. ROM is found on all motherboards.

4. It is used in graphics cards and expansion cards.

Advantages

1. Non Volatile Memory.

2. Data remains permanently inside ROM.

3. ROM forms a basic instruction set for operating the hardware.

4. It can be updated.

5. Can program BIOS.

Disadvantages

1. If ROM is damaged, the computer system cannot function.

Other Memory Chips

Apart from RAM and ROM, there are other memory chips:

Dynamic random access memory (DRAM) chips: It is a volatile memory chip since the memory is lost in this if the power supply is removed. It can only

forward a single line of memory and needs to be refreshed every time in order to prevent loss of memory bits.

Static random access memory (SRAM) chips: It is a non-volatile memory chip which is mostly used in portable batteries. It does not require refresh mode and the information remains intact in it.

First in, first out (FIFO) memory chips: It is another type of memory chip which is mostly used when there is a need of transferring of memory among different types of devices.

Erasable programmable read only memory (EPROM): In this memory chip, the data gets erased when it is open to ultraviolet rays. Such chips are then further reprogrammed for a new set of data values.

Programmable read only memory (PROM): This is a very different memory chip as it can only be programmed once. It is a good chip to save any information as the contents inside it cannot be erased electronically or by ultraviolet rays.

Check your progress 2

1. To store data permanently, we use:

   a. Hard disk   c. Floppy

   b. RAM   d. Pen drive

2. Which is not associated with LAN

   a. It's a Volatile Memory   c. It can Read and Write

   b. It has less Data Access   d. Stores Dynamic Data

1.4   Cache memory

Cache memory is also known as CPU memory which is broadly known as random access memory (RAM), is a type of memory which is integrated directly within the CPU chip. It is a type of high speed memory used in order to make the CPU perform its tasks faster. It serves as a buffer between the CPU/processor and main memory.

Such type of memory can be easily accessed by a microprocessor. It is placed directly around the microprocessor chip as shown in the Fig. 2.9.
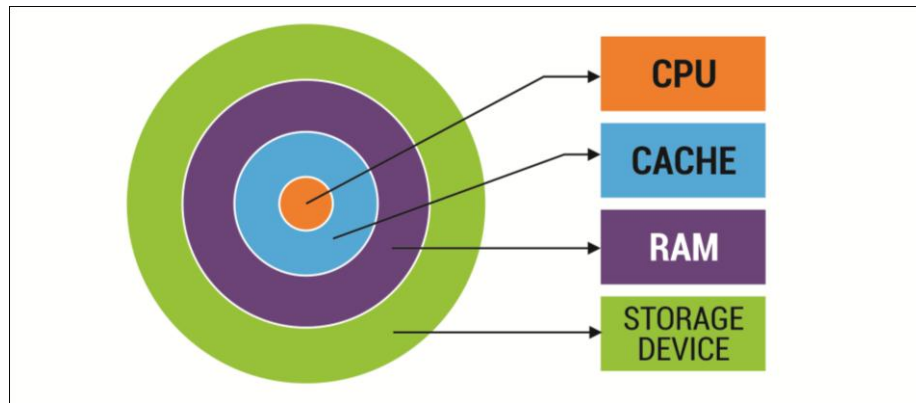
Fig. 1.3 Position of Cache Memory

Fig. 1.3 shows the arrangement of cache memory. The main function of the cache memory is to store program instructions that are frequently arranged by software at the time of operations. By accessing such instructions, the speed of the software programs is increased. After the data is processed by the microprocessor, it first sends it to the cache memory.

The important use of cache memory is to store program instructions used frequently as referenced by software at the time of operation. It has certain advantages and disadvantages.

Advantages

- Much faster.

- Requires less working time.

- Stores particular programs to be performed for a short period.

- Stores data for short-term purpose.

Disadvantages

- It has low capacity.

- It is expensive.

Check your progress 3

1. Virtual memory involves the use of _____techniques:

   a. Segmentation   c. both

   b. Paging   d. none

---

2. In equal partition, the size of the process in all the partition remains:

   a. same   c. varies with number

   b. different   d. less than 1KB

3. Which is a drawback of cache memory?

   a. It is much faster.

   b. It uses less working time.

   c. It stores particular program to be perform for short period.

   d. It has low capacity.

1.5 Let Us Sum Up

In this unit, we have learned:

- Memory is made up of one or more chips which hold the data or information temporarily during the processes are being carried out.

- Certain memories are volatile, such as RAM, in which the data gets lost when the power is switched off.

- In a nonvolatile memory, such as ROM, the data remains permanently even after the power is switched off.

- Cache memory is also known as RAM as it is integrated with the CPU chip.

- Memory chips can be RAM, ROM, EPROM, SIPO, these are either volatile or non-volatile in nature.

1.6 Answers for Check Your Progress

Check your progress 1

Answers: (1-a), (2-b)

Check your progress 2

Answers: (1-a), (2-b)

Answers: (1-c), (2-b), (3-d)

1.7   Glossary

1.   **Bit -** It is the smallest unit of a computer memory.

2.   **Byte -** A unit of memory storage that is equal to 8 bits.

3.   **CPU -** It stands for Central Processing Unit and is also known as a processor.

4.   **Memory Chip -** It is made of millions of transistors and capacitors which are assembled on an integrated chip.

5.   **MB -** It is a unit of memory storage that is equal to 1,048,576 bytes.

6.   **Primary memory -** It is the main memory that helps the processor to work.

7.   **Processor -** It is a computer component that interprets all instructions.

8.   **RAM -** It is primary memory which means random access memory. It is volatile memory.

9.   **ROM -** It means read only memory. It is a non-volatile memory.

10.   **Volatile memory -** Memory that requires power to maintain the stored information. If the power is off, the stored memory is lost.

1.8   Assignment

Prepare a report showing the different types of memory chips.

1.9   Activities

Write the major steps of comparison between the different types of memory chips.

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1.10 Case Study

Highlight the important features of volatile and nonvolatile memory and compare it with practical presentations.

1.11 Further Readings

1.   The Indispensable PC Hardware Book. Addison-Wesley.

2.   Introduction to Direct Access Storage Devices, M. Bohl, IBM.

3.   Dandamudi, Sivarama P., Fundamentals of Computer Organization and Design, Springer.

4.   Goda, K., Kitsuregawa, M. The History of Storage Systems.

UNIT 2: LOGICAL BUS

Unit Structure

2.0   Learning Objectives

2.1   Introduction

2.2   Logical-bus architecture of PC

2.3   Introduction to Buses-FSB, PCI Bus, and USB

2.4   Let Us Sum Up

2.5   Answers for Check Your Progress

2.6   Glossary

2.7   Assignment

2.8   Activities

2.9   Case Study

2.10 Further Readings

2.0   Learning Objectives

After learning this unit, you will be able to understand:

- Logical bus structure.

- The different types of Buses.

2.1   Introduction

In a computer, bus is a set of connections such as cables, circuits, etc. that can be shared by various hardware components so that they can communicate with each other. The idea of buses in the computer hardware is to lower the amount of passage required for communication among various components by using a single communication channel.
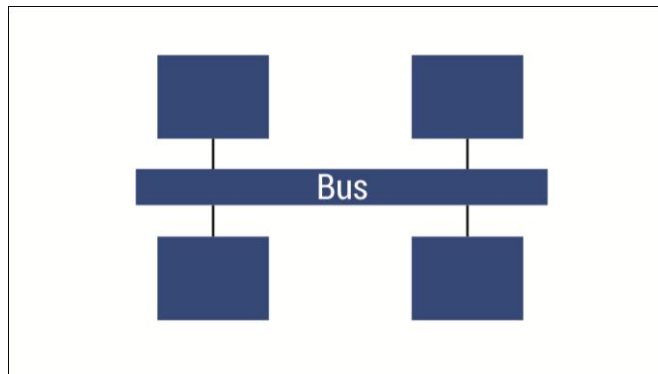
Fig. 2.1 Arrangements of Buses

Fig. 2.1 gives us an idea about the buses in computer hardware that connect various components internally. They are characterised by the amount of information that can travel among them at once. Such information is expressed in a bit, which corresponds to the number of physical lines with which the data can be sent at the same time.
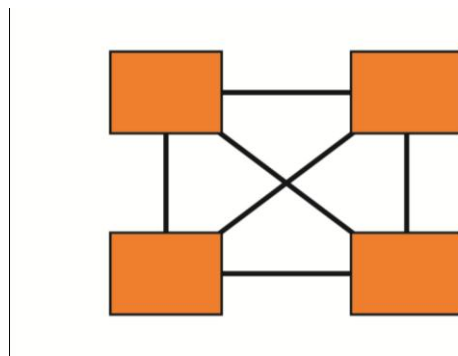
Fig. 2.2 Logical Bus Structure

2.2   Logical bus architecture of PC

In a computer system, a bus is a connection made between two or more than two devices. Normally, in a computer there are two types of buses available:

1.   **Internal bus:** It is sometimes known as front side bus or FSB bus. It allows the CPU or processor to communicate with the system's central memory (RAM).

2.   **Expansion bus:** It is sometimes called as input/output bus which allows various components located on the motherboard such as USB, serial, and parallel ports, cards, hard drives, CD-ROM and CD-RW drives, etc. to communicate among them.

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Fig. 2.3 shows an internal bus circuitry of a processor that communicates with the internal caches of memory as a part of CPU chip design. It is faster in operation and is independent of other computer operations. Fig. 2.3 shows an arrangement of a bus structure inside a computer.
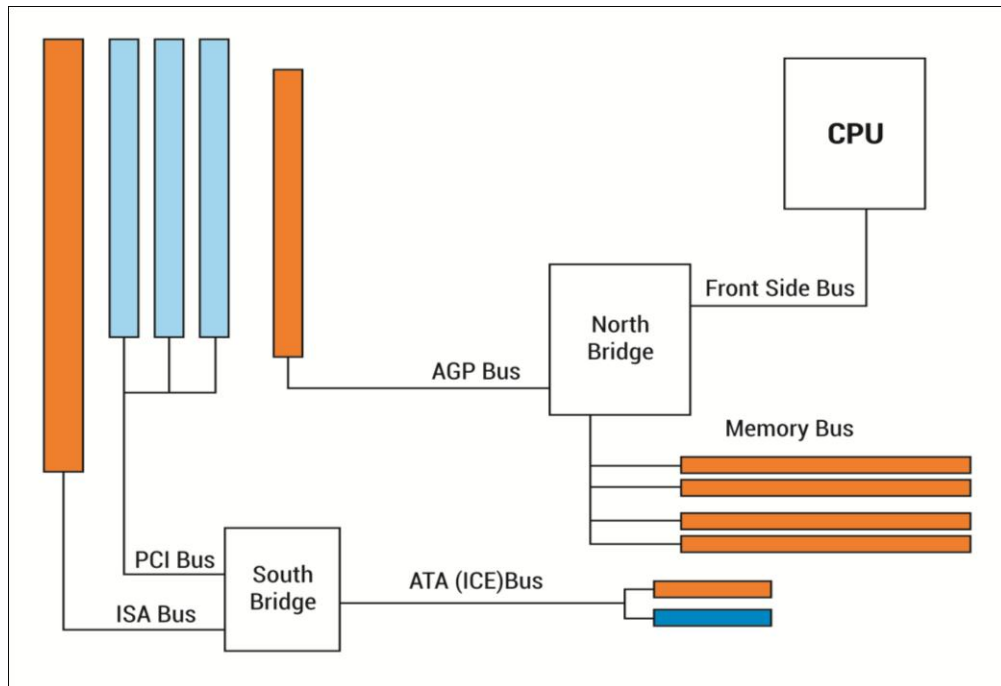
Fig. 2.3 Bus Structure of Computer

Since a bus connects many devices, it contains multiple wires which are basically signal lines having addressing information that explains about the memory location either to send or retrieve data. Every single wire carries a bit of information. Today, normally all buses whether parallel or serial are utilized by computer systems. There are two types of Buses:

- Internal bus

- External bus

An internal bus makes a communication among the internal components of a computer system such as video card and memory, where as an external bus communicates with external components of a computer system such as USB or SCSI device.

The internal bus is commonly known as system bus which comprises of four parts such as:

- **Power bus:** It has wires which gives power to every part of the main board.

- **Control bus:** It sends the timing signals out to make the other components to stay on the main board at a time with the processor.

- **Address bus:** It sends the information on memory addressing that will tell the parts installed on the main board about the instructions and data in the memory.

- **Data bus:** It transmits the real data among the system components.

Check your progress 1

1. In a computer system, _____ is a connection made between two or more than two devices.

   a. bus   c. rod

   b. line   d. plate

2. External bus can communicate with.

   a. memory   c. audio card

   b. video card   d. USB device

3. _____bus transmits the real data among the system components.

   a. Power   c. Address

   b. Control   d. Data

2.3   Introduction to Buses – FSB, PCI Bus, and USB

Bus is a serial or parallel network that joins the internal components of computer hardware through wires. Fig. 2.4 shows the arrangement of a Computer Bus.
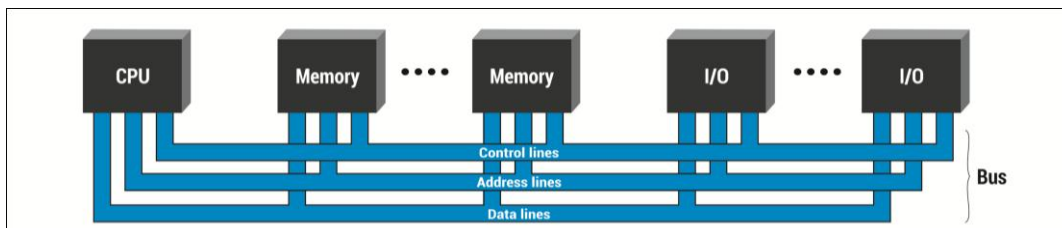

Fig. 2.4 Arrangement of Computer Bus

Fig. 2.4 shows the arrangement of a computer bus that carries three sub-assemblies:

- **Address bus:** It is sometimes known as the memory bus as it transports memory addresses which are required to read or write data. It is a single directional bus.

- **Data bus:** This bus transfers instructions received from or going into the CPU or processor. It is a two way bus.

- **Control bus:** It is also known as command bus as it can transport orders and signals that are received from the control unit moving it to all the hardware components. It is also a two way bus, as it transmits response signals from the hardware.

Types:

1. **Processor-memory bus**

   - Short and high speed.

   - Matched to the memory system to maximize the memory-processor bandwidth.

   - Optimized for cache block transfers.

2. **Backplane bus**

   - The backplane is an interconnection structure within the chassis.

   - It is used as an intermediary bus connecting I/O busses to the processor-memory bus.

3. **I/O bus (SCSI, PCI, USB, Firewire)**

   - Is usually lengthy and slower.

   - Needs to accommodate a wide range of I/O devices.

   - Connects to the processor-memory bus or backplane bus.

Characteristics

Certain features of the buses are:

   - Data and Address lines.

   - Data, addresses, and complex commands.

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- Control lines.

- Signal requests and acknowledgments.

- Indicate what type of information is on the data lines.

- Bus transaction.

- Master issuing the command (and address)   – request.

- Slave receiving (or sending) the data   – action.

- Defined by what the transaction does to memory.

- Input – inputs data from the I/O device to the memory.

- Output – outputs data from the memory to the I/O device.

Fig.2.5 Master and Slave bus characteristics

FSB Buses

It is known as the front side bus which is a computers communication bus that is used in computers that supports Intel chips. It serves as an external interface from the CPU to the other parts of the computer system, as opposed backward from where the back side bus connects the cache. Fig. 2.6 shows architecture of FSB bus system.
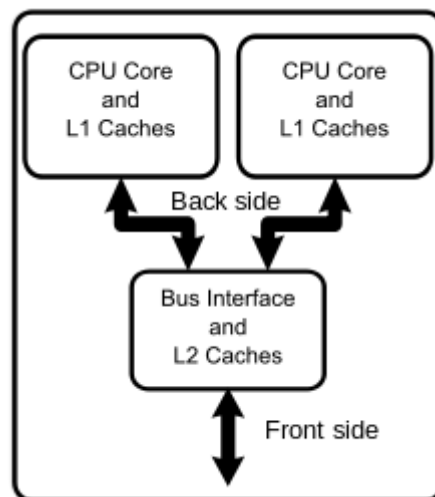

Fig. 2.6 Architecture of FSB bus

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It is frequently used in Computer motherboards, only just with data and address buses as used in fixed systems and in small computers. Such design shows a performance improvement over the single system bus designs used earlier which are still called as system bus.

PCI Buses

PCI is also known as Peripheral Component Interconnect which is a computer bus which was created by Intel in 1993. This bus can transfer 32 or 64 bits of information or data at a single time. Such a type of bus can run at a speed of 33 Mhz.

It is available in 32-bit and 64-bit versions and was commonly used to attach computer hardware. Due to advancement in Computer technology, there are many revisions which first came in the year 1993 with version 2.0 and with version 2.1 in 1995 as an expansion slot to the ISA bus. Fig. 2.7 shows an example of PCI slots on a motherboard.
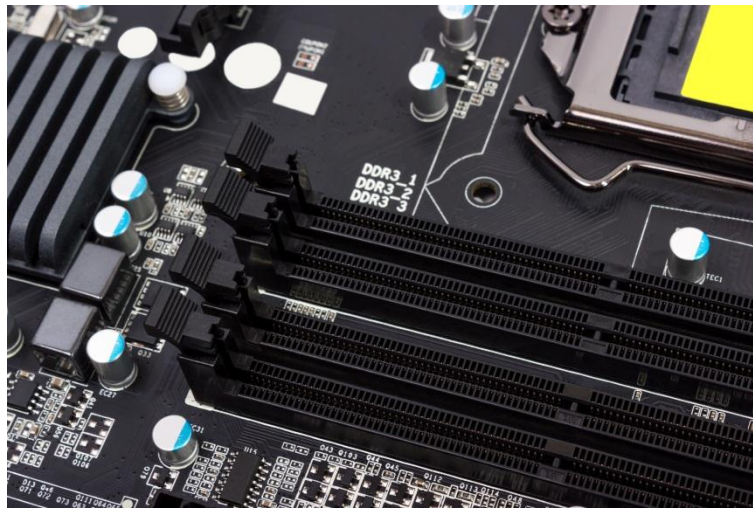
Fig. 2.7 PCI slots on a motherboard

USB Buses

USB is referred to as Universal Serial Bus which is a computer bus introduced in 1995 by Intel, Compaq and Microsoft. It is used for connecting a keyboard and mouse, and other USB devices with the computer. Normally, a USB bus has a connector with four wires out of which 2 wires are used for supplying power to USB devices. Fig. 2.8 shows an arrangement of USB bus.

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Fig. 2.8: It is an external bus standard that supports data transfer rates of 12 Mbps and is good for supporting up to 127 devices.

Check your progress 2

1. Bus is a _____ joining internal components of computer hardware.

   a. serial network

   b. parallel network

   c. serial or parallel network

   d. complex network

2. Which bus is known as memory bus?

   a. Address bus

   b. Data bus

   c. Control bus

   d. Network bus

2.4   Let Us Sum Up

In this unit, we have learned:

- ALU stands for Arithmetic and Logic Unit. It performs Addition, Subtraction, Multiplication and Division operations.

- Data paths are the internal registers or can be arithmetic and logic parts which carry the desired bus structures.

- Memory in computer architecture refers to the main or primary memory which is a collection of cells or locations.

- Control Unit is the main part of the computer architecture which controls the progress of other parts.

2.5 Answers for Check Your Progress

| Check your progress 1 |

Answers: (1-a), (2-d), (3-d)

| Check your progress 2 |

Answers: (1-c), (2-a)

2.6 Glossary

1. **Buses -** It is the physical interconnection of components with the help of wires.

2. **Data path -** These are internal registers, such as ALU and its connecting buses.

3. **Memory -** It is a collection of cells or locations.

4. **Bus bar -** It is a copper, aluminum rod like shape that conduct electricity within the switchboards.

2.7 Assignment

Prepare a report and write the various features about the logical architecture of Computer Buses.

2.8 Activities

Design an internal architecture model of a computer bus and discuss.

2.9 Case Study

Visit a Computer Hardware Store and ask about the arrangement of computer buses in the PC.

2.10 Further Readings

1. Linda Null; Julia Lobur. Essentials of Computer Organization and Architecture

2. Walter A. Elmore. Protective Relaying Theory and Applications.

UNIT 3: MOTHERBOARD

Unit Structure

3.0   Learning Objectives

After learning this unit, you will be able to understand:

- About execution of programs.

- The Fetch Decode Execution Cycle.

- About buffering.

3.1   Introduction

Motherboard is the main board of the computer. It is an assembly where all components get connected. It has lots of chips, connectors and other devices mounted on it. Inside the computer, data is regularly exchanged among the various devices as shown in Fig. 3.1.
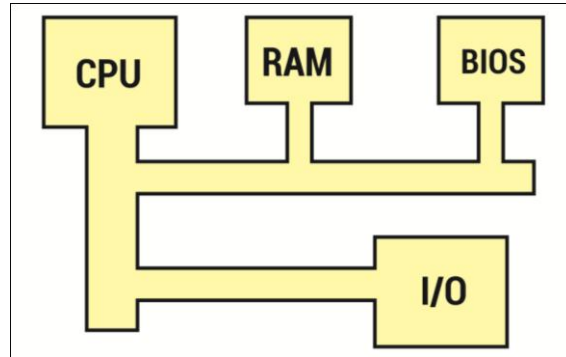
Fig. 3.1: Various devices

In the Fig. it is seen that the data exchange takes place on the motherboard itself, where all the components are connected to each other. The motherboard is made of a PCB sheet where all sockets, ICs, transistors put in.   On the motherboard, there are electrical connectors which get connected to the respective components.

3.2   Various chips on mother board

The motherboard is made of a PCB plastic sheet where all sockets, plastic brackets and screws are present. Every component that is available in the computer gets connected through the motherboard with the help of connectors. Fig. 3.2 shows the motherboard.

Fig. 3.2: Motherboard Chipset

Chips

It is a place where all active devices get assembled on the motherboard. Chips are basically small electronic circuits which are packed with transistors. There are different chips which have varied functions such as:

- **ROM chips:** It stores the BIOS and other programs.

- **CMOS:** It is a storage chip, which carries users that are used by setup program.

Chipset normally comprises of controllers, which includes a number of essential functions.

Sockets

There are sockets available on the motherboard. Sockets are holders that are fixed on the motherboard with the help of soldering. Fig. 3.3 shows the socket on the motherboard.
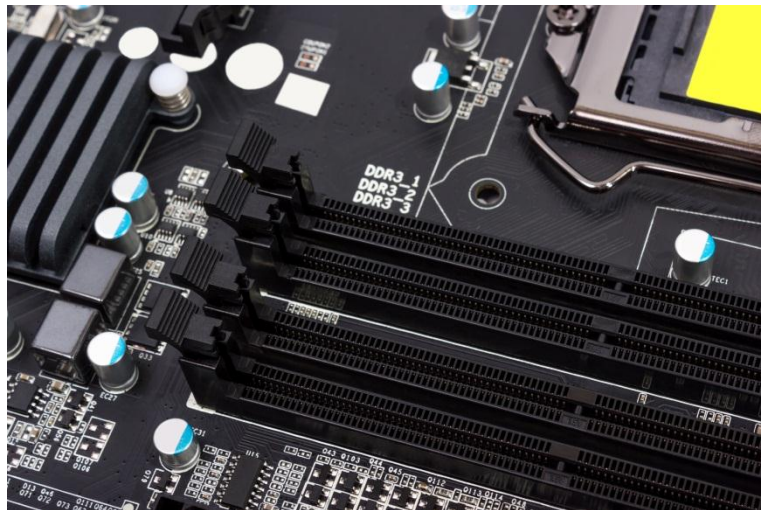
Fig. 3.3 Motherboard socket

These sockets serve as a place where certain components are fixed or mounted directly.

Sockets are the place to mount:

- Processor or CPU

- RAM

- Expansion cards

- Adapters (PCI, AGP and AMR)

The basic idea of a socket is to install the component directly on the motherboard without the use of fixing tools. The component is pushed carefully and firmly into the socket to get it fixed.

Plugs, connectors and ports

Apart from chips and sockets, motherboard carries a number of inputs and outputs, so that various components can be connected. There are certain ports which have a connector at the back to get the components connected. These ports are for:

• Keyboard and mouse.

• Serial ports, the parallel port, and USB ports.

• Speakers/microphone.

These ports or sockets are soldered on the motherboard, so that it is easy for external components such as keyboard, mouse, printer, speakers, etc., to get connected easily as shown in Fig. 3.4.
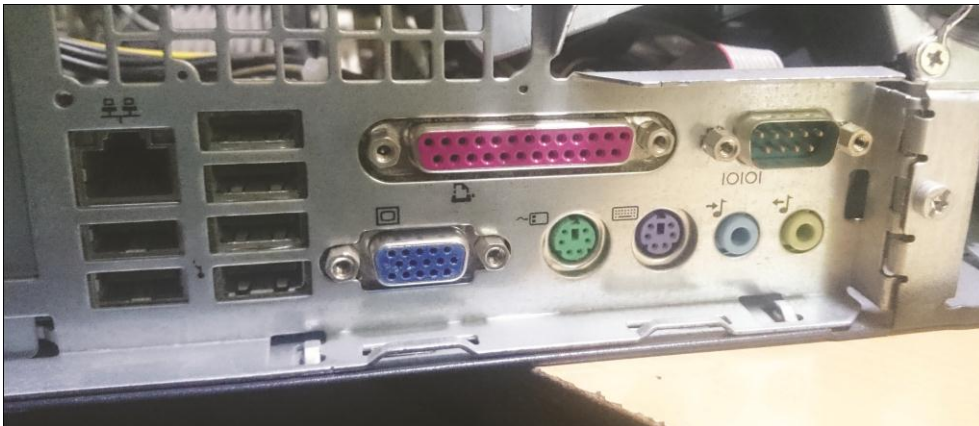
Fig. 3.4 Socket/ports on Motherboard

Apart from these sockets, there are connectors and ports on the motherboard where other components are connected.
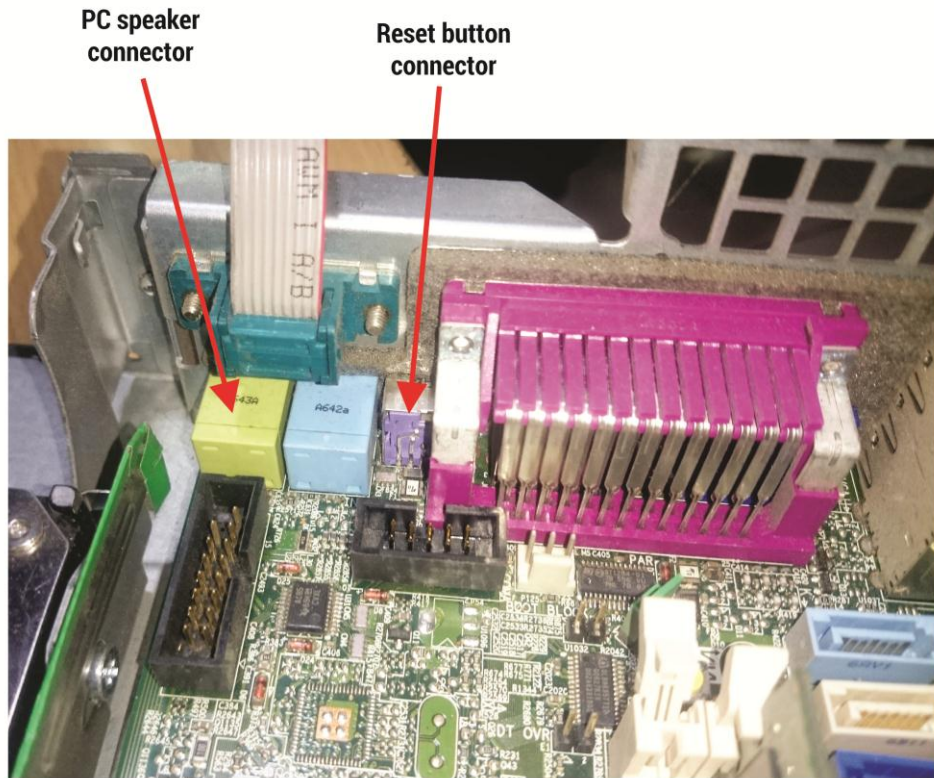
Fig. 3.5 Motherboard connectors

It includes:

- Power Supply Connector: Supply of power to motherboard and other components.

- Other connectors: These are the connectors which are used to connect a hard drive, floppy drive, CD ROM drive etc.

Apart from plugs and connectors, there are jumpers located on the motherboard, which are used to adjust the voltage and operating speed. A number of pins used to connect the reset button, LED for hard disk activity, built-in speaker, etc.
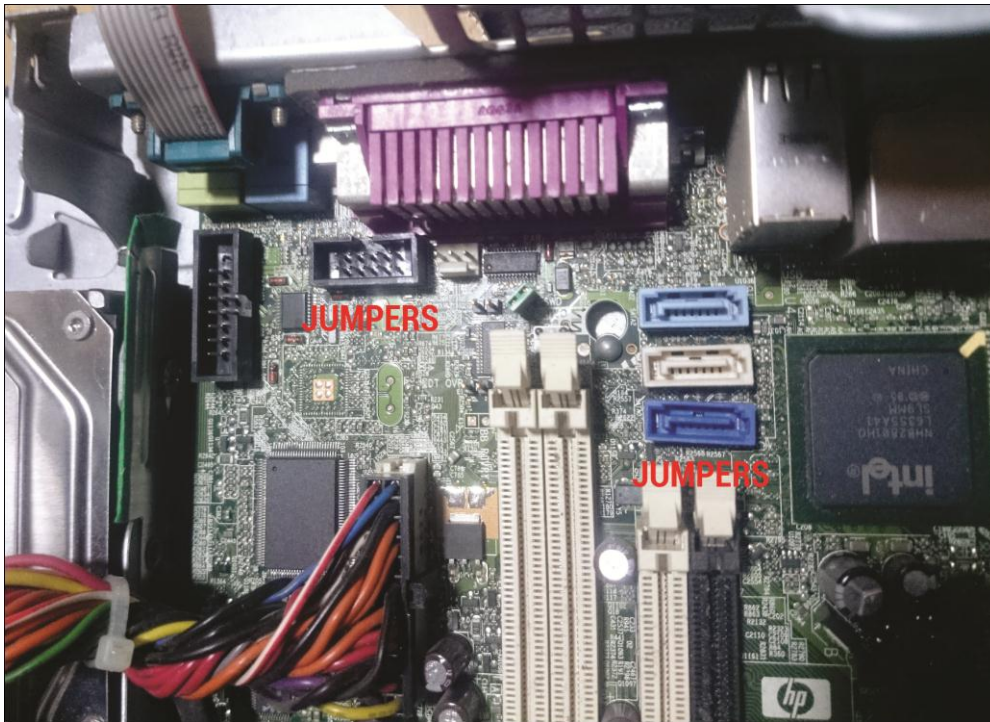
Fig. 3.6 Jumpers on motherboard

Check your progress 1

1. _____is not directly connected on Motherboard.

   a. RAM   c. CPU

   b. BIOS   d. Hard Disk

2. Motherboard is made of:

   a. Aluminium sheet   c. PCB sheet

   b. Metal sheet   d. Plastic sheet

3. Chips are small electronic circuits made of:

   a. insulators   c. conductors

   b. transistors   d. semiconductors

4. Which of the following component is not mounted directly on the Socket?

   a. Processor   c. Adapters

   b. RAM   d. Hard Disk

3.3 RAM

RAM also called as Random Access Memory as shown in Fig. 3.7 is a type of memory that temporarily stores the instructions that the computer is running, and the data it is processing.

Fig. 3.7 RAM

RAM is faster in speed and can easily read and write. The information stored in the memory gets lost when you switch off the computer or the power goes off. RAM increases the speed of your computer. When a computer is in use, its RAM will contain:

- Operating system software
- Software currently running
- Data

Check your progress 2

1. What does RAM stand for?

   a. Remote Authorization Mechanism

   b. Readily Accessed Mailer

   c. Random Access Memory

   d. Random Authorization Mechanism

3.4 L2 Cache

It is the CPU cache memory which is a Level 2 cache known as L2 caches. The L2 cache feeds the Level 1 cache and hence L2 cache is known as cache of

the L1 cache. This type of CPU cache is built in the same way as L1 caches, into the CPU but often it is located in another chip or in a Multichip Package Module which is a fully different chip.

With its exceptions, L2 caches are sometimes considered as SRAM or static RAM but the memory of the computer is considered as DRAM or Dynamic Ram. A L2 cache is bigger than a L1 cache, hence the data can be easily located in L2 cache which makes the data accessing faster. Now if the data is not present in a L1 cache, then it is looked for into a L2 cache, which is bigger than L1 cache.

L2 cache memory is located on a separate chip which can be seen more quickly than the main memory of the computer. It is visualised that a famous L2 cache memory is of the size 1,024 kilobytes which is equal to 1 megabyte.

Check your progress 3

1. L2 cache is a _____cache memory.

   a. RAM   c. CPU

   b. BIOS   d. Hard Disk

2. L2 cache memory is _____than L1 cache memory.

   a. smaller   c. equal

   b. bigger   d. different

3.5   BIOS and Chipset

Bios

It is seen that you require a special kind of program to enable the CPU to communicate with other devices. Such programs are commonly called as Basic Input/Output Service (BIOS). These programs are stored in the ROM. Fig. 3.7 shows the circuitry of BIOS on motherboard.

Fig. 3.8 BIOS on motherboard

In this:

- Each program is called a service.

- Programs are stored on ROM chips.

- Programs stored on erasable media are called software.

Fig. 3.8 shows the ROM chip
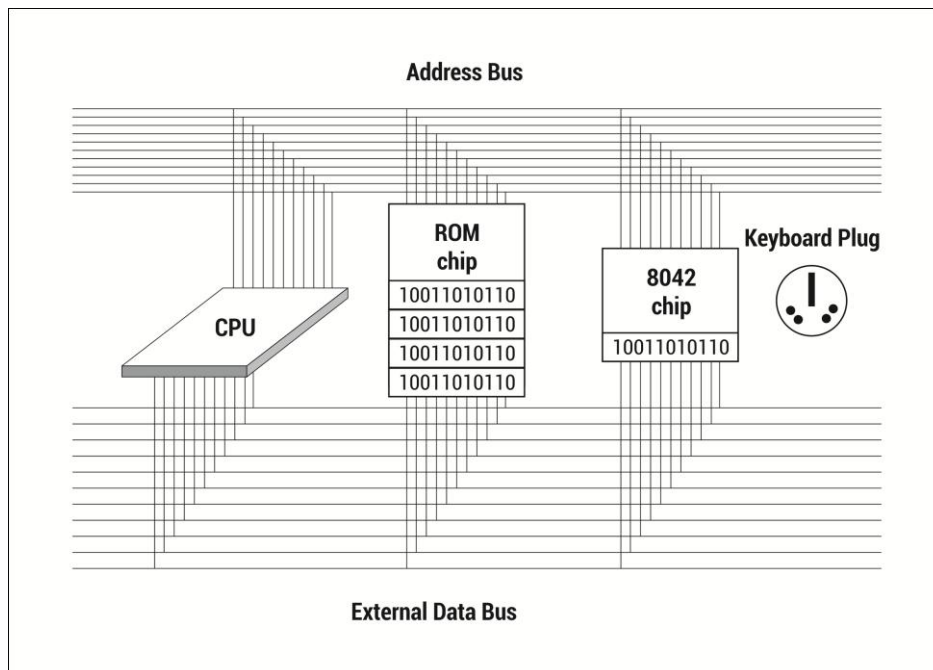
Fig. 3.9 ROM chip

Chipset

The chipset is the mixture which normally pastes the CPU or microprocessor with the motherboard and with rest of the computer. Motherboard chipsets are manufactured by Intel, VIA, Nvidia, SiS and by many other companies. There are different chipset designed for different processors. It is the duty of the manufacturer to match the respective chipset with the required processor so that they can coordinate in speed, accuracy, performance etc. Basically a chipset is an integrated part of the motherboard; hence it cannot be removed or upgraded. There are two different microchips that are present in a chipset:

• Northbridge

• Southbridge

The Fig. 3.9 shows the arrangement of the Northbridge and Southbridge microchip.
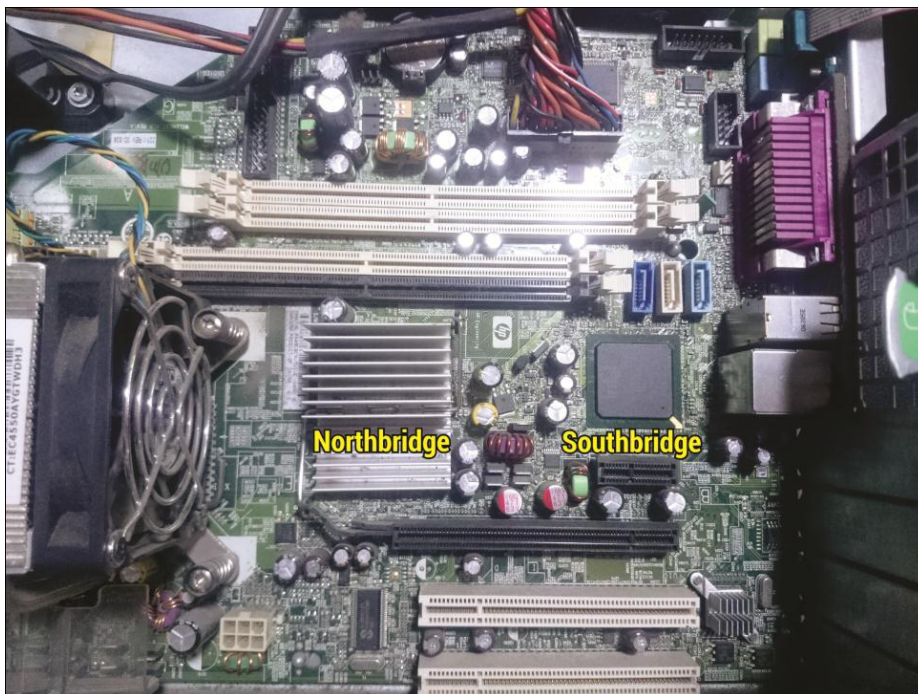
Fig. 3.10 Northbridge and Southbridge microchip

All of the various components of the computer communicate with the CPU through the chipset.

Check your progress 4

1. BIOS is

   a. Basic Input/output Service   c. Before Input/output Service

   b. Base Input/output Service   d. Basic Input/output System

3.6 Memory Controller Hub (North Bridge)

A Northbridge is also known as a Host Bridge, it is a microchip which is present on the computer motherboards which is connected directly to the CPU. A Northbridge is required in need of highest performance. The Southbridge which is known for I/O controller hub is usually grouped with the Northbridge. All communications that exist between a CPU and the respective parts of a motherboard are handled by the Northbridge and Southbridge which provide as the core logic chipset of the motherboard.

Northbridge was known to be the external memory controller hub on former motherboards when they were fitted alongside integrated VGA memory controller hubs. The qualities of this bridge have now been integrated into the CPU chip starting with memory and graphics controllers.

On the motherboard, a Northbridge connects directly to the CPU or processor from the front side bus (FSB). The CPU is made to access the memory quickly when a memory controller is established on the Northbridge. The Northbridge also connects to AGP or PCI Express bus and also to the memory itself. It is analysed that a North Bridge handles data for a graphics port as to whether the AGP or PCI expresses along with the main memory including FSB.
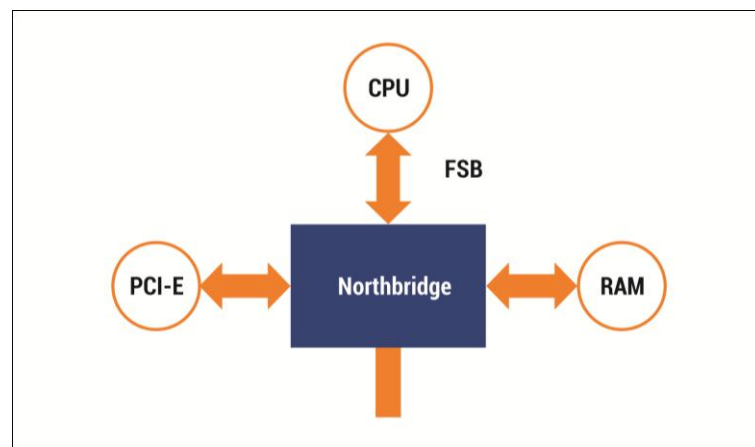
Fig. 3.11 Northbridge

3.7   I/O Controller Hubs (South Bridge)

Another microchip that is available in the core logic chipset on a computer motherboard is the Southbridge which is responsible for enacting slower functions on the motherboard chipset. . It is named as I/O Controller Hub for Intel (ICH), while Fusion Controller Hub (FCH) for AMD. Southbridge can be distinguished from Northbridge as it is not directly linked to the CPU. It is seen that a Southbridge chipset can handle all computer I/O functions like USB, audio, serial, system BIOS, ISA bus, interrupt controller and IDE channels.
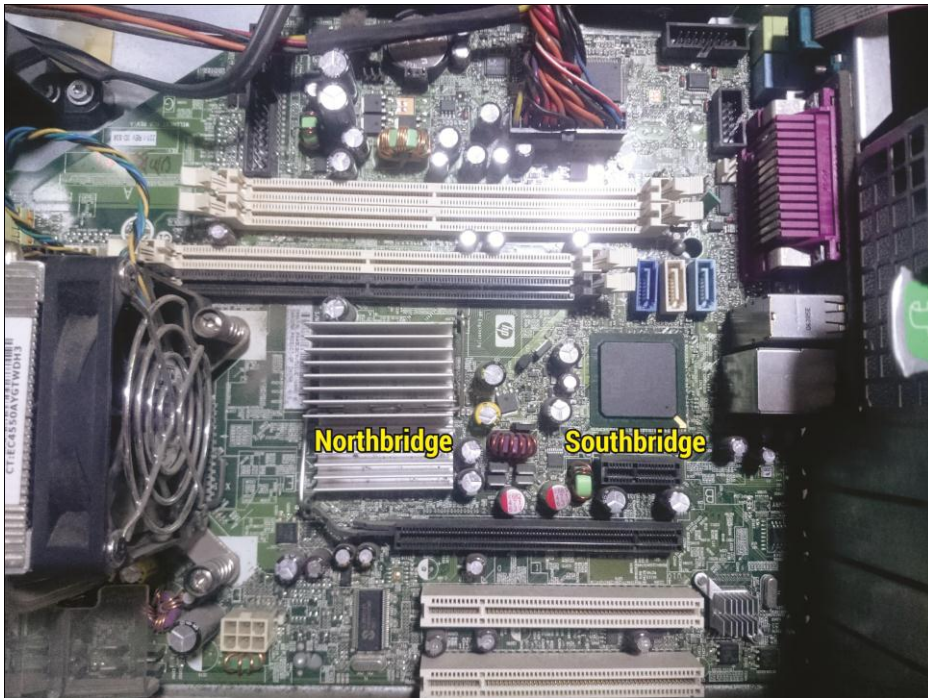
Fig. 3.12 Arrangement of Southbridge

Fig. 3.11 shows an arrangement of a Southbridge. This bridge will handle data from the PCI x1 slot having integrated components as Audio and/or on board graphics. The Southbridge is rather sluggish since the information from the CPU

first progresses toward the Northbridge and then reaches the Southbridge. Here the Southbridge is connected to the PCI bus, the USB ports and the IDE or SATA hard disk connections through busses.

Check your progress 6

1. Southbridge is known for _____ controller hub.

   a. input   c. input/output

   b. output   d. memory

2. Southbridge chipset cannot handle functions like.

   a. USB   c. system BIOS

   b. audio   d. speed of CPU

3.8   Let Us Sum Up

In this unit, we have learned:

- Motherboard is the main board of any computer system that carries and supports all hardware attached to it. All hardware components are connected on motherboard with the help of wires.

- It is seen that motherboard is a chipset where different chips are soldered on it. Every chip has its own function. There are certain sockets, plugs, ports available on motherboard which connects several other components.

- Northbridge and Southbridge are two microchips of a chipset available on the motherboard.

3.9   Answers for Check Your Progress

Check your progress 1

Answers: (1-d), (2-c), (3-b), (4-d)

Check your progress 2

Answers: (1-c)

Check your progress 3

Answers: (1-c), (2-b)

Check your progress 4

Answers: (1-d)

Check your progress 5

Answers: (1-d)

Check your progress 6

Answers: (1-c), (2-d)

3.10 Glossary

1. **Motherboard -** Principal printed circuit board assembly in a computer system.

2. **Chipset -** It is a combination of two or more integrated circuits that controls interface among system processor, RAM, I/O devices and adapter cards.

3. **Port -** port is an interface connector which is used to connect numerous types of devices.

4. **USB -** Universal Serial Bus - a medium speed interface typically used for mouse, keyboards, scanners, display panels (control features, not data), speakers (control features, not sound), scanners, and some digital cameras.

5. **Connector -** a series of two or more metal pins assembled on the motherboard or PCB to attach different cables on the motherboard.

6. **Jumper -** it is a series of two pin groups used to set CPU performance.

3.11 Assignment

Give reasons why L1 cache memory is faster than L2 cache memory.

3.12 Activities

Write the series of steps, how the motherboard will help other components to work after all is connected to it.

3.13 Case Study

Locate what components are present on the motherboard chipset.

3.14   Further Readings

1.   Computer Organisation by Goldberg

2.   Computer Architecture by Sarah Harris

3.   Computer Mainframes by Almasi and Gottlieb

UNIT 4: HARDWARE COMPONENTS OF SMARTPHONE

Unit Structure

4.0   Learning Objectives

After learning this unit, you will be able to understand:

- The hardware of Smart phone.

- The basic functions of various hardware of a Smartphone.

- The various features of a Smart phone.

4.1   Introduction

A Smartphone is a type of mobile phone that can work similarly as a computer. It has a touch pad, touch screen, internet connectivity, internet browsing, music, watching movies, downloading applications and several other features. Since it carries such different advance features, hence it is known as a Smartphone. Smartphones are manufactured by many companies and are commonly available with different models, sizes, features and characteristics.

It is seen that a Smartphone carries a number of hardware components such as:

- applications processor

- baseband chip

- communications chips (Bluetooth, GPS functions, Wi-Fi)

- graphics processor

- memory for operating system

- data user applications

Features of Smartphone:

- Contains recognized mobile operating system, as Nokia's Symbian, Google's Android, Apple's iOS or the BlackBerry OS.

- Internet connectivity.

- Mobile browser.

- Good synchronization.

- Embedded memory.

- Hardware and/or software-based QWERTY keyboard.

- Wireless synchronization with compatible devices as laptop or desktops.

- Ability to download and run applications.

- Support for third-party applications.

- Ability to run multiple applications simultaneously.

- Touchscreen.

- Wi-Fi.

4.2   Applications Processor

A smartphone processor is similar to that of a computers processor. Since it performs similar functions as computer and has the same memory and capacity, so in order to handle all this, companies now are stressing on to develop good mobile processors that can support all necessary applications in no time. Fig. 4.1 shows a diagrammatic view of application processor.
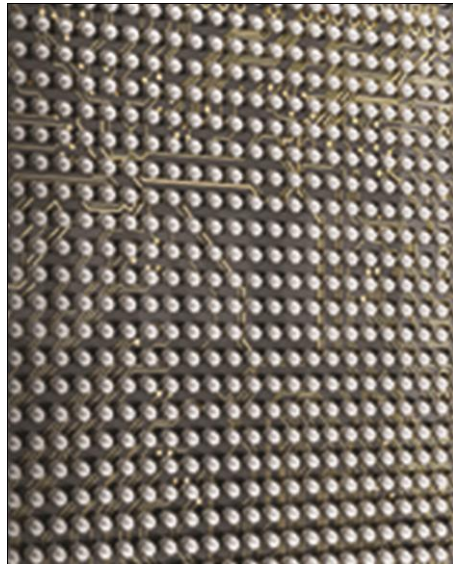
Fig. 4.1 Diagrammatic view of application processor

An application processor is a self-contained operating environment which delivers the required system capabilities which is needed to give support to a devices application such as memory management, graphics processing and multimedia decoding. It is studied that an application processor is an advanced and powerful device operating processor which can operate at frequencies of several hundred MHz, to few GHz. Some of the high performance application processors are packaged with Package on Package (PoP) technology, which saves the motherboard space.

Application processors have certain features:

- With high processing and packaging technology, these processors are much advanced and speedy.

- They are built in small sizes and require less board space.

- Because of their small size, they are used in digital still/video cameras and mobile handsets.

- These are high speed computing devices having 1 computing core per device.

- These are multi core application processors that use extensive on-chip interconnection among the cores.

- They have high-density I/O quality.

- They have excellent thermal stability.

- They are operationally reliable.

Check your progress 1

1. Smartphone is smart because it has

   a. Touch screen   c. Downloading applications

   b. Internet Connectivity   d. all of these

2. Smartphone differs ordinary phone in

   a. features   c. shape

   b. size   d. model

3. Smartphone processor has

   a. big size chip   c. faster in working

   b. cannot fit in size   d. gets heated fast

4.3 SIM card

Every mobile phone works with the help of a SIM card. A SIM card is a subscriber identity module that stores data for GSM/CDMA mobile users. The SIM card stores the user information such as:

- user identity

- network authorization data

- personal security keys

- contact lists

- stored text messages

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Apart from this, there are security features also which are stored in the SIM card such as authentication and encryption to protect data and prevent eavesdropping. Also, a smartcard with user identity module application is normally called a SIMCARD. If you have a SIM card, then you can switch it easily from one phone set to another. In this the stored data on the SIM card can be viewed by connecting it to other Smartphone's.

Types of SIM card

There are three types of SIM cards:

- Standard

- Micro

- Nano

Every Smartphone can work with any SIM card provided the SIM card should fit in the slot designed for it.

Standard SIM Card
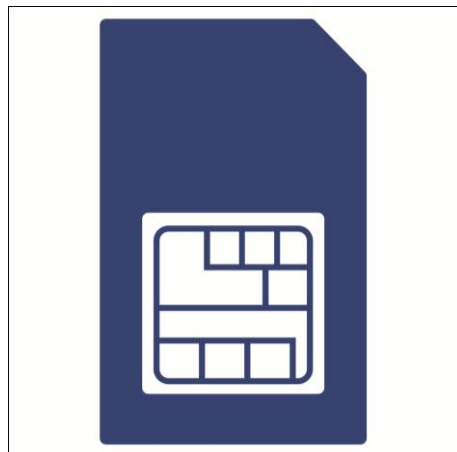
Fig. 4.2 Standard SIM Card

Fig. 4.2 shows Standard SIM Card which is used in earlier mobile phones and devices. Some of the devices that use such SIMs are:

- Apple- iPhone 3GS

- Samsung - Galaxy SII, Note

- Nokia - 300, 301

- HTC - Desire HD

- EE Mobile broadband/4G WiFi - Buzzard, Osprey

Micro SIM Card

Fig. 4.3 Micro SIM Card

Fig. 4.3 shows a Micro SIM Card which is normally smaller in size than the Standard SIM Card. It is mainly used in Smartphone's. Some of the devices that use such SIMs are

- Apple - iPhone 4/4S

- Apple iPad Retina Display

- Sony - Xperia S, T, X, Z

- HTC - One, One X, One SV, 8X

- Nokia - N9, Lumia 720/820

- Samsung - Galaxy Express, SIII, S4, Note II

Nano SIM Card

Fig. 4.4 Nano SIM Card

Fig. 4.4 shows a Nano SIM Card which is used in the latest Mobile phones and Smartphone's which is smaller than the Micro SIM card. The examples of Nano SIM devices are:

- Apple - iPhone 5, 5c, 5s and iPad Mini

- HTC - One (M8) HTC Desire 610

- Multi and Combi SIMs

Function of SIM card

- Subscriber Identification: The SIM card has IMSI programmed which is used to find a subscriber. Every IMSI is matched with a specific mobile number and temporary on HLR which allows subscriber to be identified.

- Subscriber Authentication: The SIM card authenticates the user with the help of authentication algorithm that is there on the SIM card. Each subscriber provides a unique response based on IMSI, Ki and RAND. After matching these with values calculated on the network, it logs a legal subscriber on the network to use the specific services.

- Storage: SIM card is used to store phone numbers and SMS.

- Applications: The SIM card tools allow creating applications on the SIM card to provide the basic information as required and for other applications such as m-commerce, chatting, cell broadcast, phonebook backup, location based services etc.

Check your progress 2

1. SIM card is known as:

   a. subscriber identified module   c. subscriber identity module

   b. subscriber identity modulus   d. subscriber item module

2. Which is the small sized SIM card?

   a. Standard   c. Nano

   b. Micro   d. None of these

3. In Apple-iPhone 4/4S, which SIM card is used?

   a. Standard   c. Nano

   b. Micro   d. None of these

4.4   Wireless Connectivity

Nowadays, many mobile phones including Smartphones are enabled to exchange ActiveSync that can connect to a wireless LAN. It is studied that a wireless LAN connection is faster among all networks and carries excellent coverage in areas where other networks are not proper. Wireless access is now available in almost every Smartphone. The main advantage of such connectivity is:

- Wider coverage

- Economical

- Faster Speed

- Fast browsing

- Excellent download

Check your progress 3

1. Smartphones nowadays uses:

   a. WAN connectivity

   b. LAN connectivity

   c. MAN connectivity

   d. all

4.5   Audio subsystem

Nowadays there are mobile phones which have audio input with speakers.
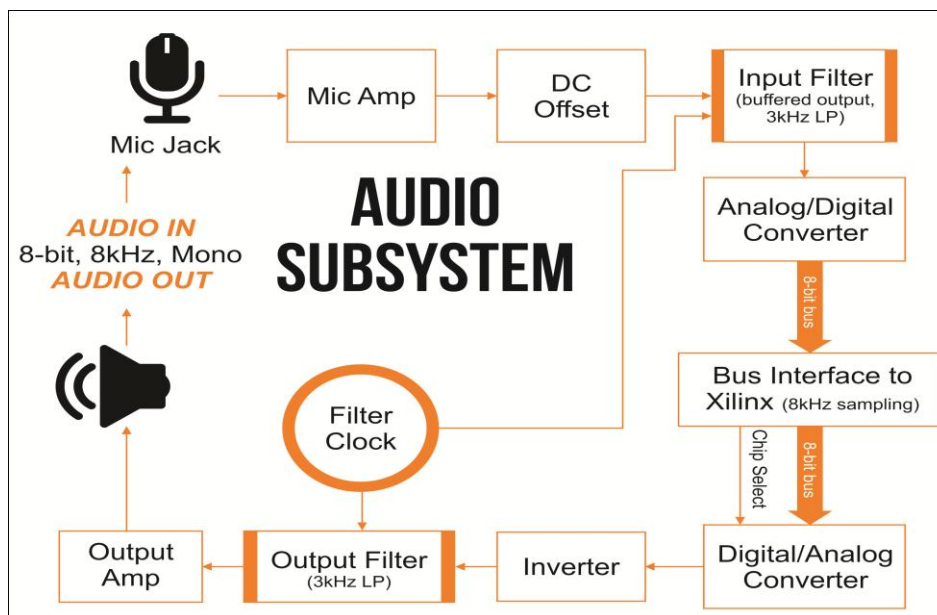
Fig. 4.5 Audio subsystem

Fig. 4.5 shows the basic structure of an audio subsystem in mobile phones. The audio subsystem delivers telephone quality audio in digital form and further playback that audio through the speaker. It is studied that the audio quality of telephone can be of 8-bit which is somewhat around 3 kHz mono speeches. As explained by the Nyquist's theorem, the sampling rate should be twice the signal frequency in order to correctly reproduce a waveform. Based on the Nyquist's theorem, the audio was best sampled with play back at 8 kHz. Further, 8 bit allows sound to be of 256 possible values having an input voltage range of 0 to 5V having step function of 0.02V / bit. It is seen that an audio subsystem comprises of two distinct systems:

- audio input (analog-digital conversion).

- audio output (digital-analog conversion).

We see that at the time of recording, audio is input by the means of a microphone which is amplified, filtered, digitized and is sent back. At the playback time, audio is converted back to analog which is filtered, amplified and gives the output by speaker.

Check your progress 4

1. Sampling of audio is explained by_____theorem.

   a. Nyquist's   c. Rutherford

   b. Pythagorean   d. none of the above

4.6   Memory card and flash memory

Memory card

Memory card is also known as a flash card which is an electronic flash memory data storage device which is typically used for keeping digital information. These are mostly used in several electronic devices such as:

- digital cameras
- mobile phones
- laptop computers
- tablets
- MP3 players
- video game consoles

Out of the above listed memory card, most of these can be very small, re-recordable and can obtain data without using power.

Flash Memory

Flash memory is an electronic non-volatile memory which can be erased and reprogrammed in units of memory known as blocks. It was invented by Toshiba in 1984 which was developed from EEPROM. There are two types of flash memory. Flash memory is so called because the microchip is arranged in such manner that a section of memory cells gets erased in single action or flash.

Similarly like RAM, flash memory will also continue to store information without the need of a power source. With this quality, the flash memory is ideal for use in:

- Smart Phones
- Digital Cameras

- Tablets

- Laptops

- MP3 Players

Similarly like ROM, a flash memory can be written off, which updates the operating system \and can be used as application software. Apart from these, the other advantages of flash memory are:

- fast access time

- compact size

- fixed

The applications of both types of flash memory include:

- personal computers

- PDAs

- digital audio players

- digital cameras

- mobile phones

- synthesizers

- video games

- scientific instrumentation

- industrial robotics

- medical electronics

Check your progress 5

1. Flash memory is not used in:

   a. Smart Phones

   b. Digital Cameras

   c. Tablets

   d. Desktops

4.7   Power Management Unit

In a smartphone the power management integrated circuits are used to handle power requirements and support voltage scaling and correct power transfer sequencing to other smartphone units or devices. Power management in a smartphone is the main component of any device as it contains a power supply, battery, or power cord, and optimizes power usage. Such integrated power system is used in electronic systems like:

- cellphones

- TVs

- computers

- smart meters

- grids

The power management circuit used in Smartphone's are herein known as Smartphone power management ICs. These integrated circuits manage power requirements of the host system. It carries a PMIC which covers battery operated devices as mobile phones and portable media players. In a Smartphone, these power management circuits perform the following functions:

- Battery charging

- Power source selection

- Voltage scaling

- Power sequencing

- supply power to related Smartphone components

It is observed that 4G Smartphone's use large battery for searching signals, which are currently limited in case of 3G signals as they consume more battery power by decoding high levels of data that is transmitted in the spectrum. Also, mobile users are now using their devices regularly for talk, text, email, web surfing, viewing high definition videos, GPS maps, video calls, play games and listen music.

Apart from this, the user demand for high display resolution and better touch functionality. Such features majorly consume high battery power, so there is a need for effective power management.

Check your progress 6

1. In Smartphone, the role of power management integrated circuits:

   a. handles power requirements

   b. support voltage scaling

   c. correct power transfer sequencing

   d. all of these

4.8   Camera & its Interface

Nowadays every Smartphone is coming up with a camera. Camera phones are easy and simple as compared to digital cameras. Since digital standalone cameras have fixed-focus lenses and smaller sensors which limits their performance under bad lighting. A smartphone has a high definition camera which has resulted in lower sales of digital cameras. It is seen that many Smartphone's only have a single start for camera applications and a simple on-screen button to start. The main advantage of a camera in a cell phone is basically its cost and compactness. Smartphones with cameras can run mobile applications such as geo-tagging and image capturing. These high end phones use a touch screen to operate the camera to focus on the required object. However, touch screen, as general purpose control, has no quickness of different camera's particularly with buttons and dial(s).
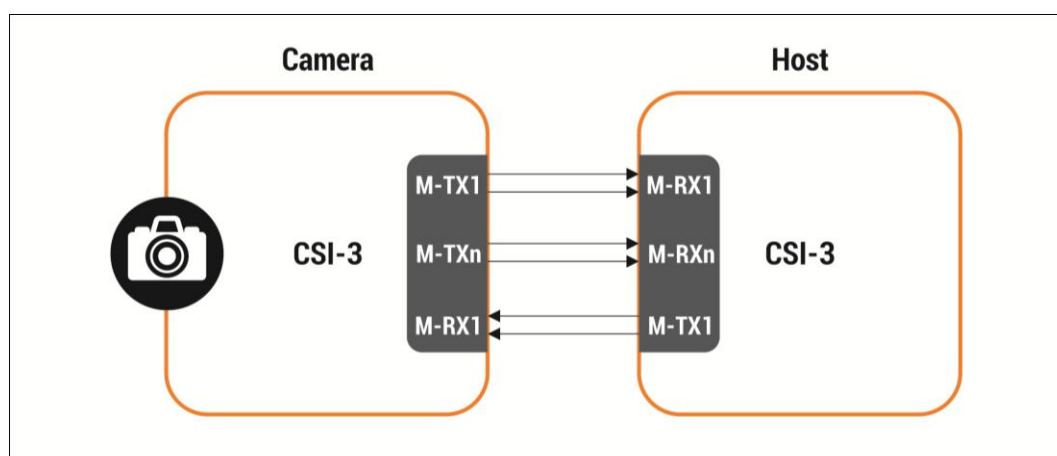

Fig. 4.6 Camera interface

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Since long the mobile manufacturers have needed a standard interface so as to attach a cameras subsystem to an application processor. With this a CSI-2 was developed as shown in Fig. 4.6 that will support a range of devices in mobile products. As a user continues to change, MIPI meets new generation cameras serial interface which is required for many camera applications. The camera systems in mobile phones support both still and video cameras. In this, high resolution sensors give digital zoom, and high pixels that are required for still or moving images with much high frame rates.

Check your progress 7

1. Old cameras will perform:

    a. catching of still images   c. capturing moving images

    b. catching of videos   d. capturing live auditions

2. The main feature of Digital Camera is:

    a. catching of videos   c. capturing live auditions

    b. capturing moving images   d. all of these

4.9 Touch screen & its interface

Practically speaking, a touch screen is an input device which is put on the top of any electronic visual display of an information processing system which enables the user to control the information processing system with the help of simple and easy multi touch gestures. Users operate the device by simply touching the screen with their fingers. Many touch screens contain specially coated gloves to work with while some can be operated by a special pen. While using a touch screen, the user can see the displayed information and can control the device by simply following instructions displayed on touch screen. The touch screen helps the user to interact directly with the displayed information, rather than using a mouse or any other intermediate device.

Touch screen comprises of four layers:

1. Top layer is of polyester coated with a transparent metallic conductive coating on the bottom.

2.   Second layer is of adhesive spacer.

3.   Third layer has glass which is coated with a transparent metallic conductive coating on top.

4.   Fourth layer is an adhesive layer which is on the backside of the glass used for mounting.

Touch screens are commonly available in devices such as:

•   game consoles

•   personal computers

•   tablet computers

•   smartphones

Check your progress 8

1. Touch screens are not available in:

   a. game consoles   c. smartphone

   b. personal computers   d. zip drives

4.10 Let Us Sum Up

In this unit we have learned:

•   That there are certain hardware components that are present inside the smartphone's. Because of this variation in hardware, smartphone carries specific features.

•   There are specific characteristics configuration and components present that makes a mobile phone to work smart. There are exceptional applications that can run with various components present in a smartphone which makes us to distinguish among 3G and 4G Smartphone's mechanism.

•   There are variety of touch screens that carries special coated gloves to work as many carries special pen. While using a touch screen, the user can see the displayed information and can control the device by simply following instructions displayed on touch screen.

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4.11 Answers for Check Your Progress

Check your progress 1

Answers: (1-d), (2-a), (3-c)

Check your progress 2

Answers: (1-c), (2-a), (3-b)

Check your progress 3

Answers: (1-b)

Check your progress 4

Answers: (1-a)

Check your progress 5

Answers: (1-c)

Check your progress 6

Answers: (1-d)

Check your progress 7

Answers: (1-a), (2-d)

Check your progress 8

Answers: (1-d)

4.12 Glossary

1. **Memory card -** It is the storage memory of a smartphone which stores data upto 32GB.

2. **3G -** It is a type of wireless mobile technology which gives access to internet connection in smartphones.

3. **4G -** It is a high speed mobile network compatible with latest smartphones.

4. **GPS -** It is a navigation application available in smartphones.

5. **Smartphone -** It is a mobile communications device that uses an identifiable open OS.

4.13 Assignment

Study the different types of Smartphone available in the market.

4.14 Activities

Collect information on a 4G Smartphone from the market and discuss.

4.15 Case Study

Does the application processor of a smartphone bear the same speed as a processor found in a computer system?

4.16 Further Readings

1. Johnson, E.A. (1965). "Touch Display - A novel input/output device for computers".

2. Hoober, Steven (2013-11-11). "Design for Fingers and Thumbs Instead of Touch.

3. Building a Better Battery, NY Times, 2 February 2014, BRIAN X. CHEN.

4. Gye, Lisa (2007) Picture This: The Impact of Mobile Camera Phones on Personal Photographic Practices.

Block Summary

In this block we have given knowledge related to Logical Architecture of Computer and Smartphones. Here the students will be trained with basic Computer motherboard working and detailed with various hardware related to it. The knowledge related to various bus architecture will make the students to create interest about learning computer hardware.

The block helped the students with the introduction of memory and cache memory. Features related to smartphone were explained with detailed description. The knowledge about motherboards and its related bus structure will made the student to enter into chip level repairing. So this unit stresses on the execution, decoding and carrying out of necessary applications that will help to work with computer and smartphone hardware.

Block Assignment

Short Answer Questions

1. What is a Computer Memory?

2. What is Buffering?

3. What are registers?

4. What do you mean by Program Counter?

5. What is the function of ALU?

Long Answer Questions

1. What is the role of CPU in Computer architecture?

2. How can a Data be written on a Hard Drive?

3. How registers are different from Program Counters

Enrolment No.

1. How many hours did you need for studying the units?

Unit No	1	2	3	4
Nos of Hrs				

2. Please give your reactions to the following items based on your reading of the
    block:

Items	Excellent	Very Good	Good	Poor	Give specific example if any
Presentation Quality	☐	☐	☐	☐	———— ————
Language and Style	☐	☐	☐	☐	———— ————
Illustration used (Diagram, tables etc)	☐	☐	☐	☐	———— ————
Conceptual Clarity	☐	☐	☐	☐	———— ————
Check your progress Quest	☐	☐	☐	☐	———— ————
Feed back to CYP Question	☐	☐	☐	☐	———— ————

3. Any Other Comments.

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> " *Education is something which ought to be brought within the reach of every one.* "

- Dr. B. R. Ambedkar

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ARCHITECTURE OF COMPUTERS

BLOCK 3:
DEVICES FOR DISPLAY, INPUT AND POINTING

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ARCHITECTURE OF COMPUTER

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ROLE OF SELF INSTRUCTIONAL MATERIAL IN DISTANCE LEARNING

The need to plan effective instruction is imperative for a successful distance teaching repertoire. This is due to the fact that the instructional designer, the tutor, the author (s) and the student are often separated by distance and may never meet in person. This is an increasingly common scenario in distance education instruction. As much as possible, teaching by distance should stimulate the student's intellectual involvement and contain all the necessary learning instructional activities that are capable of guiding the student through the course objectives. Therefore, the course / self-instructional material are completely equipped with everything that the syllabus prescribes.

To ensure effective instruction, a number of instructional design ideas are used and these help students to acquire knowledge, intellectual skills, motor skills and necessary attitudinal changes. In this respect, students' assessment and course evaluation are incorporated in the text.

The nature of instructional activities used in distance education self-instructional materials depends on the domain of learning that they reinforce in the text, that is, the cognitive, psychomotor and affective. These are further interpreted in the acquisition of knowledge, intellectual skills and motor skills. Students may be encouraged to gain, apply and communicate (orally or in writing) the knowledge acquired. Intellectual-skills objectives may be met by designing instructions that make use of students' prior knowledge and experiences in the discourse as the foundation on which newly acquired knowledge is built.

The provision of exercises in the form of assignments, projects and tutorial feedback is necessary. Instructional activities that teach motor skills need to be graphically demonstrated and the correct practices provided during tutorials. Instructional activities for inculcating change in attitude and behavior should create interest and demonstrate need and benefits gained by adopting the required change. Information on the adoption and procedures for practice of new attitudes may then be introduced.

Teaching and learning at a distance eliminates interactive communication cues, such as pauses, intonation and gestures, associated with the face-to-face method of teaching. This is particularly so with the exclusive use of print media. Instructional activities built into the instructional repertoire provide this missing interaction between the student and the teacher. Therefore, the use of instructional activities to affect better distance teaching is not optional, but mandatory.

Our team of successful writers and authors has tried to reduce this.

Divide and to bring this Self Instructional Material as the best teaching and communication tool. Instructional activities are varied in order to assess the different facets of the domains of learning.

Distance education teaching repertoire involves extensive use of self-instructional materials, be they print or otherwise. These materials are designed to achieve certain pre-determined learning outcomes, namely goals and objectives that are contained in an instructional plan. Since the teaching process is affected over a distance, there is need to ensure that students actively participate in their learning by performing specific tasks that help them to understand the relevant concepts. Therefore, a set of exercises is built into the teaching repertoire in order to link what students and tutors do in the framework of the course outline. These could be in the form of students' assignments, a research project or a science practical exercise. Examples of instructional activities in distance education are too numerous to list. Instructional activities, when used in this context, help to motivate students, guide and measure students' performance (continuous assessment)

PREFACE

We have put in lots of hard work to make this book as user-friendly as possible, but we have not sacrificed quality. Experts were involved in preparing the materials. However, concepts are explained in easy language for you. We have included may tables and examples for easy understanding.

We sincerely hope this book will help you in every way you expect.

All the best for your studies from our team!

ARCHITECTURE OF COMPUTER

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LCD and LED monitors (for PC)

UNIT 2 **INPUT AND POINTING DEVICES**

Keyboard and mouse (for PC and Laptop), touch pad (for laptop), touch screen (for Mobile) – basic principle of each device and its interface with computer

---

BLOCK 4: **DEVICES FOR NETWORKING, I/O AND EXTERNAL STORAGE**

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Modem, Wireless Modem etc.

UNIT 2 **I/O AND EXTERNAL STORAGE**

Pen Drive, Camera, Hard Disk, Optical Storage (CD/DVD),

Drives for CD/DVD, Inkjet Printers and laser printers

Dr. Babasaheb
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PGDCA 101

ARCHITECTURE OF COMPUTER

BLOCK 3: DEVICES FOR DISPLAY, INPUT AND POINTING

BLOCK 3: DEVICES FOR DISPLAY, INPUT, AND POINTING

Block Introduction

We will see that a computer needs input devices to receive information. Input devices such as the mouse and keyboard are the main input devices in a computer system. The keyboard and mouse are essential components of our computer system. Almost every mobile phones are nowadays coming up with touch pad technology. Touch screen is also common at ATMs, banks, reservations, money deposition, balance transfers etc.

In this Block we will study and learn more about display monitors and pointing devices. The user will be detailed with features and usability of different types of Input, Display and Pointing devices with their compatibility in computers, laptops and mobile phones. The knowledge related to touch pads and touch screens with their operation in laptops and mobiles are also detailed.

After studying this block, user or students will learn certain specific types of input and pointing devices that are commonly applied in computers, laptops and mobile phones. The knowledge about various display monitors such as CRT, LCD and LED along with their resolutions and functions are well explained that made user to distinguish these.

Block Objective

After learning this block, you will be able to understand:

- About different Computer monitors.

- Various input and output devices.

- The features of touchpad and touch screens.

- The functions and features of a mouse and keyboard.

Block Structure

Unit 1:   Display Devices

Unit 2:   Input and Pointing Devices

UNIT 1: DISPLAY DEVICES

Unit Structure

1.0   Learning Objectives

1.1   Introduction

1.2   LCD Monitors.

1.3   LED Monitors

1.4   Let Us Sum Up

1.5   Answers for Check Your Progress

1.6   Glossary

1.7   Assignment

1.8   Activities

1.9   Case Study

1.10 Further Readings

1.0   Learning Objectives

After learning this unit, you will be able to understand:

- About Output device.

- About LCD Monitors.

- About LED Monitors.

1.1   Introduction

A computer takes information from the user, processes it and gives back the result. The data is entered in to the computer with the help of input devices and the result is shown on output devices.

Fig. 1.1 Layout of Output Device Monitor

To perform tasks, a computer requires input devices to receive information which is processed by the CPU and then it requires output devices to display the result. This process is known as a computer cycle.

So we can see that input devices give raw data to the computer and the output devices show the processed information. The instruction received by the input devices is calculated inside the CPU. These instructions are in the shape of a code or software program. Monitor: It is an example of an output device. A monitor takes the information and displays it on the screen.

Fig. 1.2 CRT monitor

Monitor is one of the most important output devices which is attached to the computer system to show its output. Monitors are similar to televisions and use the same technology, but with much higher resolution. Nowadays monitors are available in various sizes and shapes. A variety of monitors are:

1. Analog Monitor

2. Digital Monitor

3. Flat Screen Monitors

4. LCD Monitors

These monitors are in sizes 14 inch, 17 inch, 21 inch, 24 inch, 28 inch etc.

There are different sizes for different monitors. It is seen that a 15 inch monitor size will be 15 inches when measured diagonally taking measurements from corner to corner across the screen. Monitors are very precise in terms of their measurement as the accuracy is measured in Dot Pitch which is DPI.

Dot pitch is basically a measure of each size of a small dot which a monitor usually displays. It is seen that smaller the size of dots the sharper will be the picture. The dot pitch inch of a monitor is a measure of its accuracy. Further, if the dot pitch rating is smaller for a particular monitor, more of these tiny dots could squeeze inside a square inch.

1.2   LCD Monitors

LCD is known as liquid crystal display which was first discovered in 1888 by Austrian botanist Friedrich Reinitzer. Since 1990s, the main application of LCD technology is in computer monitors that can be desktops or laptops. They are less in power consumption, light weight and smaller in size which has made LCD screens much common as compared to CRT.

Many Desktops and laptop snow come with a LCD display. TFT-LCD is a variant of LCD which conquered the earlier CRT computer monitors. The first LCD displays appeared in 1990s with a high price. As prices have lowered over a period of years the technology became popular by 1997 and it led to competition with CRT monitors. The first desktop LCD computer monitor was the Eizo L66 which came in the year 1990. Later came the Apple Studio Display and Apple Cinema Display. After 2003, TFT-LCDs outsold CRTs for the first time and

became the main technology used for computer monitors. The main contrast between CRT and LCD is:

CRT

- Bulky, heavy, use vacuum tube technology.

- Using technology that was developed in the 19th century.

LCD

- First LCD laptop monitors were very small due to manufacturing costs.

- Light, sleek, energy-efficient, have sharp picture.

Features:

- They are used for displays in notebooks, small computers, pagers, phones and other instruments.

- It uses a combination of fluorescent-based backlight, color filters, transistors, liquid crystal to create and illuminate images.

- Earlier it was only used in notebook computers and other portable devices.

- By 1997, full size LCD monitors served as an alternative for CRT monitors.

Advantages

Physical Size

- It is compact and lightweight.

- It requires less space.

- It can be fixed on a wall or panel.

Display Size

- It is similar as compared to CRT display.

- It has smaller display as compared to typical CRT monitor.

- It comes in many sizes 15", 17", 21".

- It has a good diagonal measurement as compared to CRT.

Power Consumption and Radiation Emission

- It uses less energy.

- It is more durable.

- It has more brightness.

- It consumes less watts than a CRT monitor.

- It lowers electricity consumption.

- It blocks the light rather than emit the light.

Viewing

- It is not strenuous to eyes.

- It does not flicker or glare.

Colour

- It has unlimited colour display.

- It has better resolution as compared to CRT.

- It has multiple video resolutions.

Response Time

- It has faster response time.

Disadvantages

Resolution

- It displays only the best resolution.

Viewing Angle

- It has a smaller viewing angle as compared to CRT.

- It can be viewed only from the front.

- Side view makes the image to disappear.

Price

- It is expensive as compared to CRT.

- Not much energy savings for an individual use.

Installation

- It requires a plug interface to connect to the computer.

- Many times it requires a special digital plug interface to work.

- It requires extra hardware for plugging as video card or adapter.

Response Time

- It is much slower.

- It causes delay which results in ghost effect on images.

Check your progress 1

1. Which of the following gives an image on the screen

   a. Monitor   c. Speakers

   b. Printer   d. Keyboard

2. Which among the following is an output device

   a. Monitor   c. Mouse

   b. Keyboard   d. All of above

3. Monitors can be:

   a. Analog Monitor   c. Flat Screen Monitors

   b. Digital Monitor   d. All

4. First LCD monitor was used in the year

   a. 1990   c. 1935

   b. 2001   d. 1919

1.3   LED Monitors

LED is known as Light Emitting Diode Monitors. A LED monitor or a LED display is a flat screen or a flat panel computer monitor or television. It has less depth and is light in weight. The LED monitors differ from LCD monitors in terms of backlighting. It is a computer monitor which does not use cold cathode technology and fluorescent technology.

White LED lights are jammed around the rim of the screen and diffuse evenly which is termed as edge lighting. LED lights are equally spaced behind the screen, and are either controlled or not controlled by local dimming option.

Advantages

- LED backlighting saves energy.

- LED offers better colour quality and clarity.

- LED has faster refresh rates.

- Local dimming option found in LEDs shows fine tuning of colour.

- LED provides better true colour contrast.

- LED produces dynamic and realistic images.

- LED monitors are thinner as they light around the edge of the panel.

Comparing LED to LCD Monitors

LED and LCD are both computer monitors having colour displays. The main difference between them is lighting technology: cold cathode fluorescent lighting vs. light diodes. The table below shows the difference between LCD and LED.

Resolution	LCD Monitor	LED Monitor
Contrast Ratio	12,000,000:1	100,000,000:1
Brightness	250 cd/m²	250 cd/m²
Weight	5.3 pounds	5.3 pounds
Energy rating	no	yes

Resolution

- Big screens show better resolution.

- Resolution is the amount of picture pixels into the number of pixels down.

- Pixels are small dots which are the smallest unit to form a picture.

- More pixels led to good colorful and color brightness.

Contrast Ratio

- It refers to shading qualities among black and white.

- Higher ratio led to accurate colour reproduction.

Brightness

- It refers to image quality and visibility.

Weight

- LED is lighter than LCD.

- LED and LCD monitors are less in weight as compared to CRT monitors.

Energy Star

- LCD monitors are 40% energy efficient as compared to CRT monitors.

- LED monitors are 20% energy efficiency than LCD monitors.

Check your progress 2

1. LED is known as

   a. Light Emitting Diode Monitors   c. Light Emitting Diode Motherboard

   b. Light Editing Diode Monitors   d. Light Erasable Diode Monitors

2. Display in LED monitors are

   a. curved   c. rectangular

   b. squared   d. flat

---

3. Which is not correct in LED Monitors?

   a. has better color quality   c. slow refreshing rates

   b. good clarity   d. has true colour contrast

4. Which is not the correct feature about resolution?

   a. Small screen better resolution

   b. It is the amount of picture pixels into number of pixels down

   c. Pixels are small dots that form a picture

   d. More pixels more colour brightness

1.4 Let Us Sum Up

LED and LCD monitors are both used in computers. Both differ in their own specifications. Basically LCD and LED are colour monitors as both can be used for computer display. If you are a simple computer user, you probably will not notice the difference between the two. They differ with CRT monitors in terms of weight, cost, performance, and resolution and power consumption. LCD and LED monitors both offer thin profiles and are lightweight and energy efficient.

1.5 Answers for Check Your Progress

Check your progress 1

Answers: (1-a), (2-a), (3-d), (4-a)

Check your progress 2

Answers: (1-a), (2-d), (3-c), (4-a)

1.6 Glossary

1. **Luminance -** It is a measure of brightness and its unit is candelas per square meter.

2. **Aspect ratio -** Ratio of horizontal length to vertical length of monitor.

3. **Resolution -** Number of different pixels of different dimension for display.

4. **Dot pitch -** Distance between sub pixels of the same color.

5. **Contrast ratio -** Ratio of luminosity of the brightest color to the darkest color produced by the monitor.

6. **Viewing angle -** Maximum angle at which images on the monitor can be viewed.

1.7   Assignment

These are the most common _____ device and include desktop monitors known as _____ Ray Tube monitors (CRT) and Liquid Crystal Displays (LCDs). CRT monitors are large and have a _____ screen and look similar to your TV. They are easy to keep clean, relatively cheap and are robust. However, they can be noisy, they produce a lot of _____ and they take up a lot of room. LCD monitors are _____ and lighter than a CRT and also use much less power. This makes them ideal for where there is a lack of space for example on lap-top computers. The downside is they are more _____ than a CRT and they can be damaged by sharp objects.

1.8   Activities

LED monitors and LCD monitors have objective and measurable specifications. Comment.

1.9   Case Study

If you are a regular computer user, how will you notice the difference between LCD and LED monitors?

1.10 Further Readings

1. Studying Cathode Ray Tube Monitors by John S.

2. LED monitors, A good resolution monitor by Ronald

UNIT 2: INPUT AND POINTING DEVICES

Unit Structure

2.0   Learning Objectives

2.1   Introduction

2.2   Keyboard

2.3   Mouse

2.4   Touch pad (for laptop)

2.5   Touch screen (for Mobile)

2.6   Let Us Sum Up

2.7   Answers for Check Your Progress

2.8   Glossary

2.9   Assignment

2.10 Activities

2.11 Case Study

2.12 Further Readings

2.0   Learning Objectives

After learning this unit, you will be able to understand:

- The functions of a computer mouse.

- The basics of a laptop touch pad.

- The functions of a mobile touch screen.

2.1   Introduction

Input devices are what are used to input data into the computer. Without them you could not tell the computer what to do. A keyboard is an input device. On pressing the keys of a keyboard, you are telling the computer what to do. Mouse is also an example of an input device. When we click the mouse button and move the mouse, it tells the computer what to do. When you move the mouse,

the mouse cursor on the screen will also move. Apart from these there are more Input devices such as:

- **Digital Camera:** It is an input device. It takes the picture that you can put into the computer. The picture becomes the information inside the computer.

- **Scanner:** Scanner is an input device. You can put a picture into the computer by using the scanner. The scanner takes the picture information and puts it into the computer.

- **Trackball:** A trackball looks like an upside-down mouse where you have to move the wheels to make the pointer in the direction to go. It is used in the places where there is no flat surface to move the mouse. They are used with video games.

- **Joystick:** Joystick is also an input device which is often used for playing games. They can move in 8 directions and have buttons attached for extra functions.

- **Microphone:** Microphone is a common input device which is used to input sound. It is used to record sound.

- **Webcams:** Webcam is an input device which is used to capture images so that the person sitting far away can see you in his computer. It is most commonly used in video conferencing where people can meet and talk across the globe.
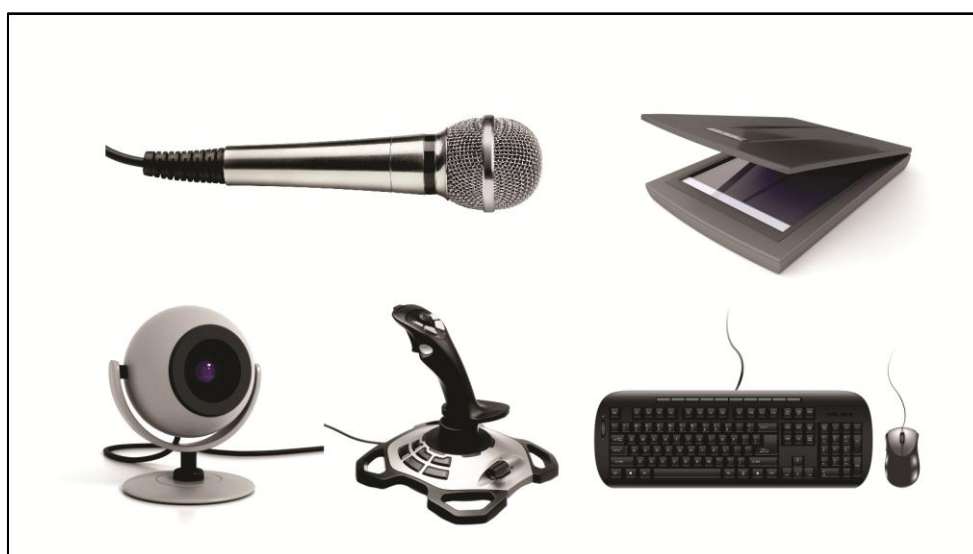
Fig. 2.1 Different input devices

2.2   Keyboard

An Input Device is a hardware device that sends information into the CPU or processor. Without any input devices a computer would simply be a display device and not allow users to interact with it. A keyboard is the most common input device. It is a common way of entering information into a computer. There are many kinds of keyboards available. The keyboard normally has 104 keys as shown in figure 2.2.

Fig. 2.2 104 keys keyboard

Keyboards are one of the main input devices used in computer systems as they are used to give input to the computer as shown in figure 2.3.

Fig. 2.3 keyboard to feed information to computer

Computer keyboard is similar to the keyboards of electric typewriters. It comes with some additional keys. Keyboard is basically used to type data.

Types of Keyboard Keys

There are a number of keys located on the computer keyboard as shown in figure 2.4.
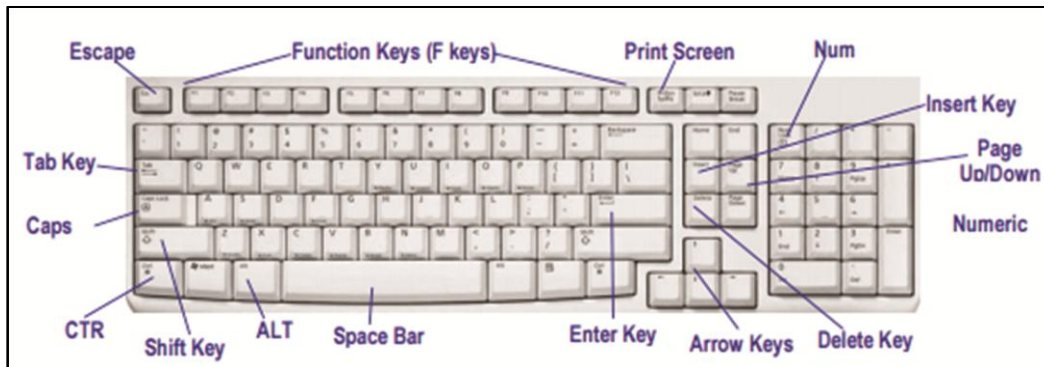

Fig. 2.4 Keys on keyboard

- **Alphanumeric Keys:** It carries alphabet keys from A-Z, numeric keys from 0 to 9 and some special characters such as + □ / * ( ) etc.

- **Function Keys:** They are located on the top of keyboard and are marked from F1, F2, F3... F12. They are user programmable keys.

- **Special-function Keys:** These keys are designed to perform special functions.

- **Enter keys:** There are 2 Enter keys on the keyboard. This key is similar to return key which is used to execute a command or program.

- **Spacebar key:** It is the longest key on the keyboard which on pressing gives a space at the current cursor location.

- **Backspace key:** It is located at the middle upside on the keyboard. When this key is pressed, then the cursor will move to one position left and delete the characters in that position.

- **Delete key:** It is an important key as it deletes the character at current cursor position.

- **Insert key:** This key is used to insert the data.

- **Shift key:** This key is used to type capital letters and special characters of the keyboard.

- **Caps Lock key:** This key when pressed writes the alphabets in capital.

- **Tab key:** It is a type of key when pressed moves the cursor to the next tab position in the document.

- **Ctrl key:** This key is used along with other keyboard keys to provide functions on the keyboard.

- **Alt key:** This is another keyboard key which is used with other keys to perform the required tasks.

- **Esc key:** This key is used to cancel or abort the particular command or program.

- **Numeric Key:** Numeric keys are located on the Numeric keypad which is placed on the right side of the keyboard. These keys are numbered from 0 to 9. It carries some mathematical operators such as + □ * /.

- **Cursor Control Keys:** It is a set of 4 keys that moves the cursor in up, down, left, right directions.

Check your progress 1

1. To come on new line, we use_____keyboard key

   a. Control   c. enter

   b. Spacebar   d. alt

2. The keys showing alphabets on keyboard are known as:

   a. Enter key   c. Alphabet key

   b. Numeric Key   d. Caps lock key

3. There is(are) _____Spacebar key on keyboard

   a. one   c. three

   b. two   d. no

4. When you press the Ctrl, Alt, and Delete keys simultaneously it causes the computer to

   a. sleep   c. Help a problem

   b. Lock Up   d. Does nothing

2.3   Mouse

Mouse or a computer mouse is also an example of an input device. It is used both in a Laptop and a Computer. A Mouse is an input device that was invented in 1963. It allows an individual to control a pointer so it is also called a pointing device. By using a mouse a user can perform various functions such as opening or closing a program or file on a single click. The mouse clicking action is shown in figure 2.5.

Fig. 2.5 Mouse Clicking

Mouse Actions

- **Single Click:** It selects the particular item on the screen.

- **Double Click:** It is used to open a program or a file.

- **Right Click:** when pressed gives different commands to perform the action.

- **Drag and Drop:** It selects and moves an item from one place to another.

When we click the mouse button and move the mouse, then it tells the computer what to do. When you move the mouse, the mouse cursor on the screen will also move.

Fig. 2.6 Computer Mouse

In figure 2.6 as you move the mouse, it enables the computer to enact your moves. Every computer has buttons and you click the mouse button, you will make certain choices by telling your computer where you want to select or start.

Types of computer mouse

- Cordless

- Foot mouse

- Glide point

- IntelliMouse

- J mouse

- Joystick

- Mechanical

- Optical

- Touchpad

- Trackball

- TrackPoint

- Wheel mouse

Features of Mouse

1. It is an input device.

2. It points things on computer screen.

3. It selects an item.

4. It is made of plastic, hence it is light.

5. It is cheaper.

Check your progress 2

1. When you click on the start button and then click on all programs, then it will.

   a. Display all files   c. Display categories

   b. Open Excel   d. Close a program

---

2. An onscreen image changes as you

   a. Right-Click   c. Mouse-Over

   b. Left-Click   d. Double-Click

3. Mouse actions are

   a. Left Click   c. Double Click

   b. Right Click   d. All of these

2.4   Touch Pad (for laptop)

A touchpad is a pointing device that has sensors and special surface which translates the movement and position of the user's fingers to a particular point that is required by the software. Touchpad are mostly used in laptop computers where it serves as the purpose of a physical computer mouse. Touchpad depends on the size as per the need of laptops. Figure 2.7 shows the laptop touchpad.

Fig 2.7 Touchpad of laptop

Apart from laptops, touchpad's are also found on personal digital assistants (PDAs) and in many portable media players. Mostly, touchpad's are found in self-contained portable laptop computers located close to the keyboard. They have a smooth surface where you have to move your finger to give the mouse pointer certain commands or instructions.

Check your progress 3

1. Touchpad is not used in

   a. desktop computers   c. mobile phones

   b. laptop computers   d. personal digital assistants

2. Touchpad in laptop computer serves the use of

   a. keyboard   c. monitor

   b. mouse   d. printer

2.5   Touch screen (for Mobile)

Touch screen is an input device which is located on top of the mobile that carries electronic visual display. It is a screen which allows the user to control the information or the system by multi touch motion. The mobile user will be able to use his device by simply touching the screen with his fingers. In mobiles that have a touch screen, there are special coated belt that uses a special device to operate such as a pen. While using a touch screen, the user can see the displayed information and can control the device by simply following instructions displayed on touch screen. Figure 2.8 shows a mobile touch screen.

Fig. 2.8 Mobile touch screens

The touch screen makes the user to interact directly with the displayed information, rather than using a mouse or any other intermediate device.

Touch screen comprises of four layers:

- Top layer is of polyester coated with a transparent metallic conductive coating on bottom.

- Second layer is of adhesive spacer.

- Third layer has glass which is coated with a transparent metallic conductive coating on top.

- Fourth layer is adhesive layer which is on the backside of glass used for mounting.

Touch screens are commonly available in devices such as:

- game consoles

- personal computers

- tablet computers

- smartphones

Check your progress 4

1. Touch screen is:

   a. pointing device   c. output device

   b. input device   d. serving device

2.6 Let Us Sum Up

In this unit, we have learned:

- That Input Unit is the primary unit of Computer System which contains various input devices such as Keyboard, Joystick, Scanner, OCR, MICR, Bar Code Reader, Light Pen and Digital Camera.

- Apart from these, a Computer keyboard is used for inputting data into the computer so that it gets processed to some useful information. Also, a computer mouse is a pointing device which is used for pointing things on screen.

- Touchpad is an input device used in computer laptops whereas touch screen is a plastic coated screen that is used on mobiles and ATMs which can be operated by sue of fingers.

2.7 Answers for Check Your Progress

Check your progress 1

Answers: (1-c), (2-c), (3-a), (4-b)

Check your progress 2

Answers: (1-a), (2-c), (3-d)

Check your progress 3

Answers: (1-a), (2-b)

Check your progress 4

Answers: (1-b)

2.8 Glossary

1. **Input Devices -** Devices used to input information to the computer.

2. **Keyboard -** It is an input device that is used to enter data into the computer.

3. **Mouse -** A computer mouse is a pointing device that points things on the monitor screen.

4. **Touchpad -** It is an input device that is used in computers or laptops which serves the purpose of a mouse.

5. **Touch screen -** Screen located at the top of the mobile phone which is used for accessing various applications on the phone.

6. **Mouse action -** There are four mouse actions which gives instructions to the mouse.

2.9 Assignment

If you press Right Arrow key and Enter key on the keyboard 8 times, then what will be the correct position of the pointer. Draw and explain.

2.10 Activities

With the help of computer mouse, press the two buttons one by one and locate the mouse action.

2.11 Case Study

If you want to type your name in capital letters, then what key will you use?

2.12 Further Readings

1.   Touchpads to Navigate by McDonough

2.   Working with computers by Malloy, Rich; Crabb, Don

Block Summary

The block gives a detailed knowledge about different types of input and pointing devices which can be used in computers, laptops and mobile phones. The basic idea about display and resolution that exists among CRT, LCD and LED monitors are made them aware to differentiate these monitors. Keyboard and mouse are essential components of our Computer system.

With the study of this block, students will be aware about various features of Input, Display and Pointing devices with compatibility in computers, laptops and mobile phones. The students will be trained along with illustrations which will helped them to gather latest and updated information.

Block Assignment

Short Answer Questions

1. What is a CRT monitor?

2. Explain what is a computer mouse?

3. What is the use of a keyboard?

4. Can a mobile phone be operated without a touch screen?

5. Name any laptop which does not have a touch pad facility?

Long Answer Questions

1. Explain the difference between LCD and LED Monitors?

2. Explain the functions of various keys on the key board?

3. What is the difference between the functions of a touch pad and touch screen?

Enrolment No. [ ]

1. How many hours did you need for studying the units?

Unit No	1	2	3	4
Nos of Hrs				

2. Please give your reactions to the following items based on your reading of the block:

Items	Excellent	Very Good	Good	Poor	Give specific example if any
Presentation Quality	☐	☐	☐	☐	_____ _____
Language and Style	☐	☐	☐	☐	_____ _____
Illustration used (Diagram, tables etc)	☐	☐	☐	☐	_____ _____
Conceptual Clarity	☐	☐	☐	☐	_____ _____
Check your progress Quest	☐	☐	☐	☐	_____ _____
Feed back to CYP Question	☐	☐	☐	☐	_____ _____

3. Any Other Comments.

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> **Education is something which ought to be brought within the reach of every one.**
>
> **- Dr. B. R. Ambedkar**

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ROLE OF SELF INSTRUCTIONAL MATERIAL IN DISTANCE LEARNING

The need to plan effective instruction is imperative for a successful distance teaching repertoire. This is due to the fact that the instructional designer, the tutor, the author (s) and the student are often separated by distance and may never meet in person. This is an increasingly common scenario in distance education instruction. As much as possible, teaching by distance should stimulate the student's intellectual involvement and contain all the necessary learning instructional activities that are capable of guiding the student through the course objectives. Therefore, the course / self-instructional material are completely equipped with everything that the syllabus prescribes.

To ensure effective instruction, a number of instructional design ideas are used and these help students to acquire knowledge, intellectual skills, motor skills and necessary attitudinal changes. In this respect, students' assessment and course evaluation are incorporated in the text.

The nature of instructional activities used in distance education self-instructional materials depends on the domain of learning that they reinforce in the text, that is, the cognitive, psychomotor and affective. These are further interpreted in the acquisition of knowledge, intellectual skills and motor skills. Students may be encouraged to gain, apply and communicate (orally or in writing) the knowledge acquired. Intellectual-skills objectives may be met by designing instructions that make use of students' prior knowledge and experiences in the discourse as the foundation on which newly acquired knowledge is built.

The provision of exercises in the form of assignments, projects and tutorial feedback is necessary. Instructional activities that teach motor skills need to be graphically demonstrated and the correct practices provided during tutorials. Instructional activities for inculcating change in attitude and behavior should create interest and demonstrate need and benefits gained by adopting the required change. Information on the adoption and procedures for practice of new attitudes may then be introduced.

Teaching and learning at a distance eliminates interactive communication cues, such as pauses, intonation and gestures, associated with the face-to-face method of teaching. This is particularly so with the exclusive use of print media. Instructional activities built into the instructional repertoire provide this missing interaction between the student and the teacher. Therefore, the use of instructional activities to affect better distance teaching is not optional, but mandatory.

Our team of successful writers and authors has tried to reduce this.

Divide and to bring this Self Instructional Material as the best teaching and communication tool. Instructional activities are varied in order to assess the different facets of the domains of learning.

Distance education teaching repertoire involves extensive use of self-instructional materials, be they print or otherwise. These materials are designed to achieve certain pre-determined learning outcomes, namely goals and objectives that are contained in an instructional plan. Since the teaching process is affected over a distance, there is need to ensure that students actively participate in their learning by performing specific tasks that help them to understand the relevant concepts. Therefore, a set of exercises is built into the teaching repertoire in order to link what students and tutors do in the framework of the course outline. These could be in the form of students' assignments, a research project or a science practical exercise. Examples of instructional activities in distance education are too numerous to list. Instructional activities, when used in this context, help to motivate students, guide and measure students' performance (continuous assessment)

PREFACE

We have put in lots of hard work to make this book as user-friendly as possible, but we have not sacrificed quality. Experts were involved in preparing the materials. However, concepts are explained in easy language for you. We have included may tables and examples for easy understanding.

We sincerely hope this book will help you in every way you expect.

All the best for your studies from our team!

ARCHITECTURE OF COMPUTER

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UNIT 1 DISPLAY DEVICES

LCD and LED monitors (for PC)

UNIT 2 INPUT AND POINTING DEVICES

Keyboard and mouse (for PC and Laptop), touch pad (for laptop), touch screen (for Mobile) – basic principle of each device and its interface with computer

BLOCK 4: DEVICES FOR NETWORKING, I/O AND EXTERNAL STORAGE

UNIT 1 NETWORKING DEVICES

Modem, Wireless Modem etc.

UNIT 2 I/O AND EXTERNAL STORAGE

Pen Drive, Camera, Hard Disk, Optical Storage (CD/DVD), Drives for CD/DVD, Inkjet Printers and laser printers

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 Ambedkar
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PGDCA 101

ARCHITECTURE OF COMPUTER

**BLOCK 4: DEVICES FOR NETWORKING, I/O AND EXTERNAL
              STORAGE**

BLOCK 4: DEVICES FOR NETWORKING, I/O, AND EXTERNAL STORAGE

Block Introduction

Networking involves connection among two or more computers. The two computers can be connected across the globe with the help of internet and networking. There are two types of modem one is with wires that is connected inside the computer system and other is wireless that is more comfortable and available nowadays. There are certain optical storage devices such as CD and DVDs where data can be stored from 10 MB to 4.6 GB.

In this block we will study and learn about networking and its devices. The concept related to various input and output storage units are explained. The mechanism of data storage with different types of magnetic and optical storage devices will help students to gather knowledge about compact disks.

The block will help readers with the basic understanding of how computers can be connected in a network and perform task. The students after reading this block will able to connect to web with the use of modem. The concept of data storage on certain devices will allow them to differentiate among hard disk and DVD storage

Block Objective

After learning this block, you will be able to understand:

* Different Networking properties.

* About storage devices.

* The features of a digital camera.

* The importance of magnetic and optical Storage.

Block Structure

Unit 1:   **Networking Devices**

Unit 2:   **I/O and External Storage**

UNIT 1: NETWORKING DEVICES

Unit Structure

1.0   Learning Objectives

1.1   Introduction

1.2   Modem

1.3   Wireless Modem

1.4   Let Us Sum Up

1.5   Answers for Check Your Progress

1.6   Glossary

1.7   Assignment

1.8   Activities

1.9   Case Study

1.10   Further Readings

1.0   Learning Objectives

After learning this unit, you will be able to understand:

- The features and functions of a modem.

- The different types of modem.

- What are Wireless Modems?

1.1   Introduction

Networking is a connection between two or more computers. The purpose of a network is to share the information among different users. Fig. 1.1 shows the networking of two computers:
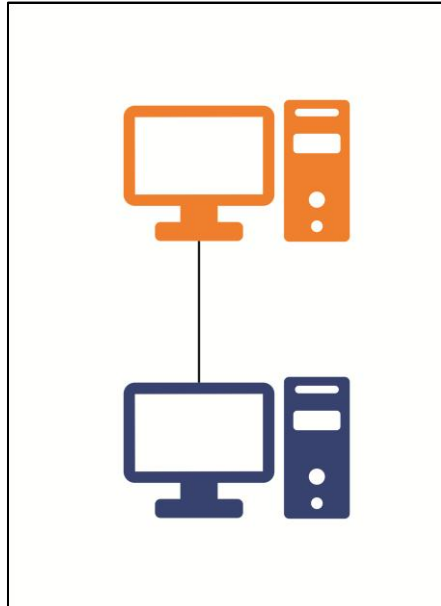
Fig. 1.1 Computer in network

Computer network consist of:

- Two or multiple computers that can be a Server or a Client.

- A Network Interface Card.

- Connection medium that can either have wires or no wires.

- Network Operating system like MS Windows, NT or MS 2000, Novell NetWare, UNIX and Linux.

Internet is a setup of computers across the globe. Every computer that is connected to the internet is considered as a part of that network. Fig. 1.2 shows the arrangement of computers in a network.
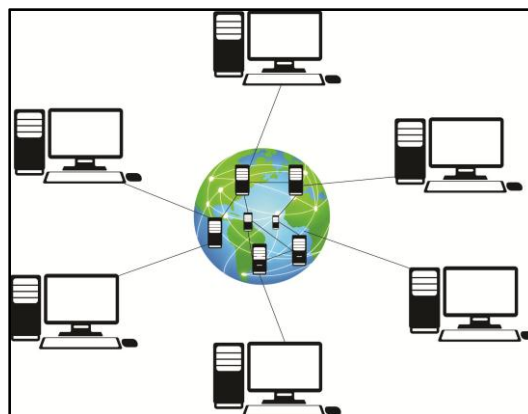
Fig. 1.2 Computers connected by Internet

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In order to share the information with people quickly and easily, we use the Internet. Internet is a collection of computers where many computers grouped together share their information. In this case the information can be sent by the Sender and the Receiver receives that information. In this chapter we will study about Internet and its working.

1.2   Modem

A modem is a device that connects your computer to a telephone line in order to transmit and receive data electronically. It is used to connect to the Internet. Modems are useful as it converts analog data which moves through the telephone lines into digital data which is used by the computers. Such process that makes use of modulation and demodulation of computer's signal into analog signals is the real meaning of the MODEM. We can say that, a modem translates computer data into the language that is required by telephones and then afterwards reversing the process in order to translate the data back into computer language.

Features:

- It is used to connect to the Internet.

- It modulates and demodulates the signals.

- Not Expensive.

- High data speed.

- Light Weight.

Types of Modems

Modems can either be internal or external.

External modem

This type of modem was used earlier along with external modems. It is connected externally with the telephone line. Such modems are easy to install they are independent of other computer hardware. This type of modem can be switched off and on individually as it has its own power supply. The telephone line is plugged into a socket on the rear panel of the modem. Fig. 1.3 shows an external modem.

Fig. 1.3 external modem

Because external modems have their own power supply, you can turn off the modem to break an online connection quickly without powering down the computer.

Internal modem

Internal modems are installed directly inside the computer system. It automatically gets ON when you open your computer. Fig. 1.4 shows an internal modem.

Fig. 1.4 internal modem

Internal modems usually cost less as compared to external modems.

To change such a modem, you have to first open the computer cabinet and then unplug it with the help of screw driver.

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Application

With the help of a modem you can connect to the internet. Internet can be connected from desktop as well as from laptop computers. To connect to the internet, you require a computer, modem and a service provider as shown in Fig. 1.5.
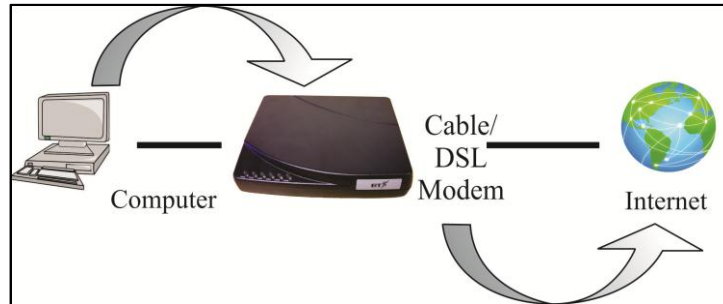
Fig. 1.5 Internet Connections

The term "Internet" was defined in the year 1995 by the Federal Networking Council as a global information system. You can connect computers through the internet as shown in the Fig. above.

Check your progress 1

1. Network is:

   a. Communication Channel   c. User network

   b. Language of Coding   d. Group of people

2. Computer Network can be:

   a. Connecting two computers   c. Connecting Hub with computers

   b. Connecting two or more computers   d. All of above

3. The general network comprises of:

   a. Sender.   c. Receiver.

   b. Communication Channel Medium.   d. All of above.

4. To connect an internet you require

   a. modem   c. cables

   b. laptop   d. monitor

1.3   Wireless Modem

Nowadays, internet users want to enjoy accessing the internet even away from their home and office place. Wireless modem is also a modem that sends or receives network signals without the use of cable connections. It accesses the internet without using any wired connectors or cable. Because of being wireless, it is much faster, reliable and is less expensive.

Today, many companies are into manufacturing wireless modems. These are designed as per the user requirements and are not expensive. Some of the famous and common wireless modems which are available include connect cards, USB sticks, Wi-Fi devices and wireless routers.

Connect Cards

It is the beginning series of wireless modems which first appeared in two versions:

- PC data cards

- Connect cards

Such wireless modems are very small and compact. They are used to provide internet facility in laptops, personal computers or routers.

USB Sticks

It is a type of stick that is connected with the wireless modem and gives good internet speed in desktops and laptops. Its size is the same as the size of a pen drive. The stick fits correctly into the USB port available in either the desktop or laptop. These sticks are not plug and play but require certain installation drivers in order to work. Such type of USB sticks are easy to carry and can work anywhere.

Mobile Hotspots

Wireless modems serve as a portable internet hotspots. Internet products such as Novatel's wi-Fi routers get a wireless broadband network and move the signal to a particular range in the same way as Wi-Fi hotspots. It will make the respective devices with Wi-Fi features along with wireless broadband network that can be of much use to the user who use Computers, Smartphone and tablets while moving here and there.

Wireless Routers

These are routers which are especially designed for home users as there is no need of a transmission cable. This router works without the internet cable and can receive or send the signal faster than a normal router.

Check your progress 2

1. Wireless modem requires

    a. a cable   c. some wires

    b. a sockets   d. no wires

2. Which among the following is not a Wireless modem

    a. connect cards   c. Mi-Fi devices

    b. USB sticks   d. PCI card

1.4 Let Us Sum Up

In this unit, we have learned:

- That a modem is an electronic device that sends and receives a signal and further transmits the signal to the other units. Modem can be with wires and wireless.

- It is studied that a wireless modem is a machine that sends or receives the network signal, without the use of cable connections. Some of the variety of wireless modems is connect cards, USB sticks, Wi-Fi devices, and wireless routers.

- So with this unit, we have learnt that in order to connect your internet, you require a modem, whether internal or external. Once the modem is connected it will send signal to the server which in turn sends it to the ISP.

1.5   Answers for Check Your Progress

Check your progress 1

Answers: (1-a), (2-d), (3-d), (4-a)

Check your progress 2

Answers: (1-d), (2-d)

1.6   Glossary

1.   **Network -** It is a relationship between the Sender and the Receiver.

2.   **Computer network -** It is an interconnection of two or more computer systems located at either same or different places.

3.   **Networking -** It is a connection between two or more computers.

4.   **Modem -** It modulates or de modulates signals to connect to the Internet.

5.   **Wireless Modem -** It is a modem that sends or receives network signals without the use of cable connections.

1.7   Assignment

Study the features of a wired and wireless modem?

1.8   Activities

Find out why your internet connection is giving an error even though you are able to connect it?

1.9   Case Study

Can a Wireless modem be taken anywhere to connect to the internet? Study and comment.

1.10 Further Readings

1.   Basic of Internet by Er. Nishit Mathur

2.   Internet and the World by Ahmed Ansari

UNIT 2: I/O AND EXTERNAL STORAGE

Unit Structure

2.0   Learning Objectives

After learning this unit, you will be able to understand:

- The features and functions of a pen drive.

- About optical storage devices.

- About a hard drive and its features.

- The functions of printers.

2.1   Introduction

Storage Devices are such devices that keep the data stored and is installed in computer desktops and laptops. There are many different types of storage devices that are used in laptops and desktop computers such as:

- Removable data Storage Devices.

- Non Removable data Storage Devices.

To store data of the user, the companies are now manufacturing the data storage devices with variety of shapes and conFig.urations. Storage devices are important as they contain the user's information and data which could be of use to him anytime.

Some of the secondary data storage devices are:

- Hard disk drives

- CD/DVD ROM

- Flash memory

- USB data Card

Secondary Storage is a non-volatile data storage which is not directly used by the CPU but will only be accessible through primary storage devices with the use of I/O (Input/Output) channels or devices. Secondary storage devices help in keeping data or media. It holds the files that are not presently being used. After changing, the changed files get saved in the secondary storage.

Secondary storage media can be removed or separated easily from the computer like diskettes, hard disks etc. Secondary storage is also known as auxiliary storage and is used to store data and programs when they are not being developed. Secondary storage is more permanent than the main memory, as data and programs are retained when the power is turned off.

2.2   Pen Drive

A pen drive is one of the most important portable storage devices which are available nowadays. It is also called a Flash drive. The Fig. below shows an arrangement of a pen drive. It is a USB drive as it is connected to the USB port in

the computer system. Pen drives are small, compact, lightweight, portable and have high data storage capacity of up to 64 gigabytes.

Pen drives work in the same way as other data storage devices such as floppy disks or CDROMs. The main advantage of such type of storage devices is that you can carry the data easily anywhere. It is more reliable and carries large amounts of data with compatible speed.

Fig. 2.1 Pen Drive

Advantages

- Compact in Size.

- Reliable.

- Cheaper in Price.

- Convenient to Carry.

- Holds data upto 64 gigabytes.

- Light weight.

- Used many times to read and write data

Check your progress 1

1. Which is not a secondary storage device?

    a. Hard disk drives   c. DVD

    b. ROM   d. CD

2. Which is a not a portable storage device?

    a. Hard disk drives   c. DVD

    b. Pen Drive   d. CD

3. Pen Drive can store data upto

    a. 16 MB   c. 64 GB

    b. 32 MB   d. 32 GB

2.3   Camera

Camera is a device used to capture still images. It has a good resolution. Nowadays due to high technology, ordinary cameras have been taken over by digital cameras.

Fig. 2.2 Digital camera

A digital camera as shown in Fig. 2.1 can store the pictures or videos it takes in electronic format instead of a film. It comprises of the LCD display that allows users to view photos or videos after they have been taken. Such type of camera shaves an ability to take dozens or hundreds of different pictures. It has a very strong Mega Pixel camera resolution. Digital cameras have unique picture quality and are relatively cheaper in price.

Features

- Contains high pixel

- Costly

- Small in Size

- Light Weight

- Stores Pictures in electronic form

Check your progress 2

1. Which is used for capturing images

   a. Monitor   c. Keyboard

   b. Speaker   d. Digital camera

2. Digital Camera stores:

   a. Digital Images   c. Text images

   b. Gif images   d. Document Images

2.4   Hard Disk

A hard disk is an internal storage device which is made of metal that is coated with magnetic oxide. Due to its magnetized structure it can be easily read and can easily represent data. There are many configurations and sizes of the hard disk.

Fig. 2.3 Hard Disk

A hard disk contains various sectors that can be assembled together in a disk pack, depending on the number of platters as per the desired models. In this, every sector in the pack contains a top and bottom surface where the data is written.

It is seen that a disk drive is a sort of a machine which allows the data to be read from the disk or can be written on the disk. In such a disk pack, the disks will rotate at a specific time and allows only a single disk to be read or written at a given time only. Such process of reading or writing of data on the disk is normally performed by an access arm. Also it is seen that when a read/write head touches

the disk surface then in that situation, the head gets crashed which will destroy the data or information on the hard disk.

Hard disk provides larger and faster secondary storage qualities than diskettes. They are fixed inside the computer and are not removable like diskettes. Most computers have two or more hard disks.

Characteristics

- Hard disks must be formatted before storing any information.

- The storage capacity for hard drives is measured in megabytes and gigabytes.

- The sizes of the computer's hard disks range from 800MB to 1 TB. .

- Has high data security.

- Hard Disk support sector method and cylinder method.

- They are nonvolatile.

Check your progress 3

1. Secondary Storage Devices are:

   a. Hard Disk   c. CD ROM

   b. Floppy Disk   d. All of above

2.5   Optical storage (CD/DVD)

Optical storage is such a type of storage device that stores the data on particular discs. In this, the data gets recorded on a particular disc which will point the modulated laser beam to a particular rotating disc. With this, a series of small pits will occur which will not be able to reflect any light. In such type of storage discs, the data to be read will allow a less power laser beam that will focus on the particular track making the reflected beam through the photo diode.
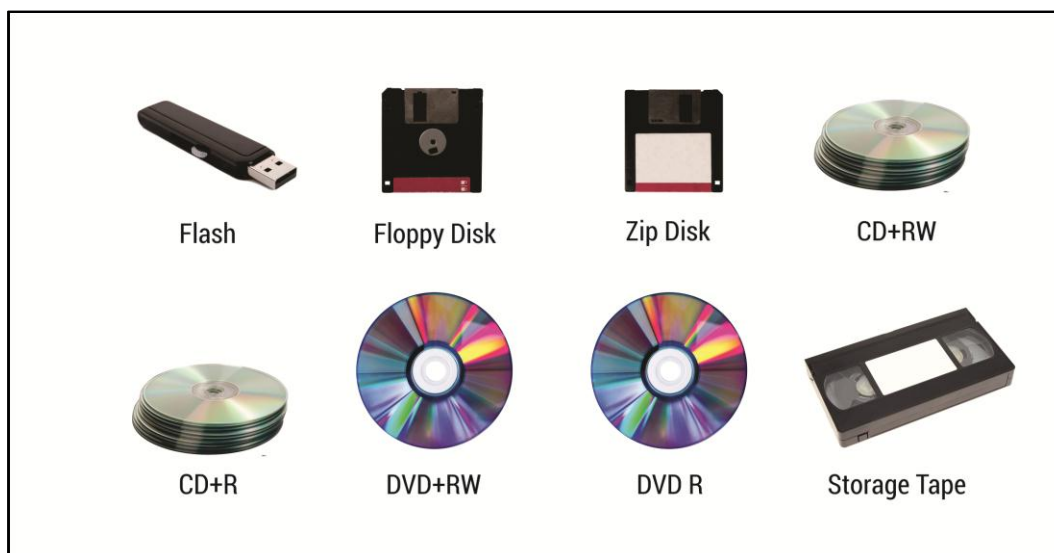
Fig. 2.4 Optical Storage Medias

The result of this is that the photo diode will find the occurrence of pits and bumps from the reflected laser beam which will convert the pits and bumps into bits and bytes of information.

Types:

- CD ROMs

- DVD ROMs

Characteristics of Optical Storage Disk:

- These disks use new technology.

- They use laser beams for the read/write operations.

- They have high storage capacity.

- They have low speed.

Compact Disk Read Only Memory is a device which is used in computers to read the information that is stored on optical disk known as CD. Here the laser beam will hit a metallic surface layer that is spread all over the metallic surface of a CD disk. After that, when data is entered on the disk, then the heat from the laser beam will produce tiny spots on all disk surfaces which will help the disk to read the data.

Fig. 2.5 CD ROM

Apart from all, the common optical technology is used in designing of CDROMs, which is a device fitted in the computer that is used to read CD disks and is known as read-only memory. Fig. 2.4 shows an arrangement of a CD disk in CDROM drive.

It is found that CD-ROM has more advantages as compared to optical disk devices. The disk format in CD discs is similar to that of an audio disk. Any CD disc can store the information or data of upto 730 megabytes, which is same as roughly 400 Floppies of 3-1/2 inches.

Fig. 2.6 CD/DVD

You must have seen that a CDROM drive comes with factor "X". This factor denotes the speed factor of the CDROM drive such as 12X, 18X, 24X, 32X and 52X. Basically this factor shows the speed at which the CD disc can transfer data to the CPU.
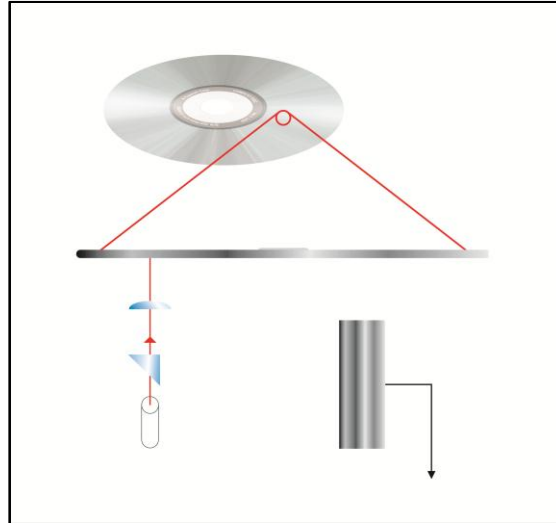

Fig. 2.7 Reading Mechanism of CD

Nowadays the CD drives are coming up with write options also. These are called as CD-RW which can be written only once, but can be read-many times.

Characteristics:

- CD ROM can store data upto 730 megabytes.

- Data stored can be zipped or unzipped.

- Compact in Size.

- Permanent Data Storage.

- It is Nonvolatile.

DVDs

A DVD is known as Digital Versatile Disk drives which have now replaced the CD drive because of its large data storage capacity. DVDs are now commonly found in computer systems that are used for media and pictures in home entertainment. Many movies and heavy media are now present in a single DVD as its storage is more.

Fig. 2.8 DVD writer

A DVD is also a flat disk just like a CD disc of 4.7 inches in diameter and .05 inches in thickness. It contains a spiral track which is used to store data similarly as found in a CD. Because of its advanced technology, the DVD disks are read by a laser beam which is of shorter wavelength as compared to the CD disc used earlier.

The prominent capacity of data storage in a DVD is around 4.7 GB which can be used to play for 135 minutes with high quality and resolution. In order to achieve such high quality, the data or graphic transmission rate is around 4692 bits per second. The DVD disc is read by the DVD drives which also has the "X" factor such as 2X, 4X, etc, depending on the speed factor. Due to such quality in a DVD disc, it becomes difficult for DVD drives to replace the magnetic hard disks.

Characteristics

- It's a Digital Disk.

- Compact in Size.

- Store data upto 45 gigabytes.

- High reading speed.

- Works same as Hard Disk.

Advantages

- High Data Speed.

- Store large data.

- Good for storing multimedia files.

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- Compact.

- Durable.

- High Data Security.

- Cheaper in price.

Check your progress 4

1. Which doesn't come under CDs?

   a. CD-R   c. Pen Drive

   b. CD-RW   d. CD ROM

2. What amount of data can be stored in DVD?

   a. 1 GB   c. 7 GB

   b. 3 GB   d. 4 GB

2.6   Drivers for CD\DVD

The CD or DVD needs drivers with earlier operating systems. In order to make your CD or DVD work, your operating system should contain drivers to run the hardware. The earlier windows operating system 3.22 needs drivers to make CD Rom drive to run. The operating system which is coming nowadays will carry an in built software driver to run CD or DVD.

You can check your driver status for CD or DVD in the device manager. Clicking on the device manager will show the presence of all hardware that your systems carry. The drive files contain exe and other supported file that will make the CD or DVD to work. It is seen that both CD and DVD contains similar drivers.

Check your progress 5

1. Drivers for CD and DVD are:

   a. same in features   c. same in length

   b. same in size   d. same for both

2.7   Inkjet and Laser Printers

Printer is an output device that takes information from the CPU and transfers it to paper. It is a device that produces printed output, because it is real and permanent. There are many printers that will print only letters and numbers apart from graphics and images.

Types of Printers

- **Impact Printers**

This type of printer makes use of certain physical contact with the paper in order to generate an image. In this the image is formed with the help of striking paper, ribbon and hammer. The printing is a combination of all the three, and if anyone is not performing will not generate the output.

In such type of impact printers, the impact is obtained by a print hammer character which will strike a printing ribbon to the paper, or the printing can be obtained by printing the hammer with the paper and the ribbon against some particular character. Such types of printers were used earlier as it requires special attention at the time of printing. One of the examples of an Impact printer is a dot-matrix printer. This is a slow printer as it prints dot by dot. In case of high quality impact printers, the printing is only one character at a particular time.

- **Non-impact Printers**

Non-impact printer is another type of an impact printer in which an image is placed on a page without touching that particular page. The main examples of non-impact are laser printers and ink-jet printers.

Ink Jet Printer

Ink Jet printer is another type of printer that generates the character by spraying a small amount of ink on the paper. They are nowadays cheaper than dot matrix printers. These printers are quiet in operations and have good print or picture quality.

Fig. 2.9 Ink Jet Printer

They are available with Black and Coloured ink cartridges. They are used for printing letters and photographs.
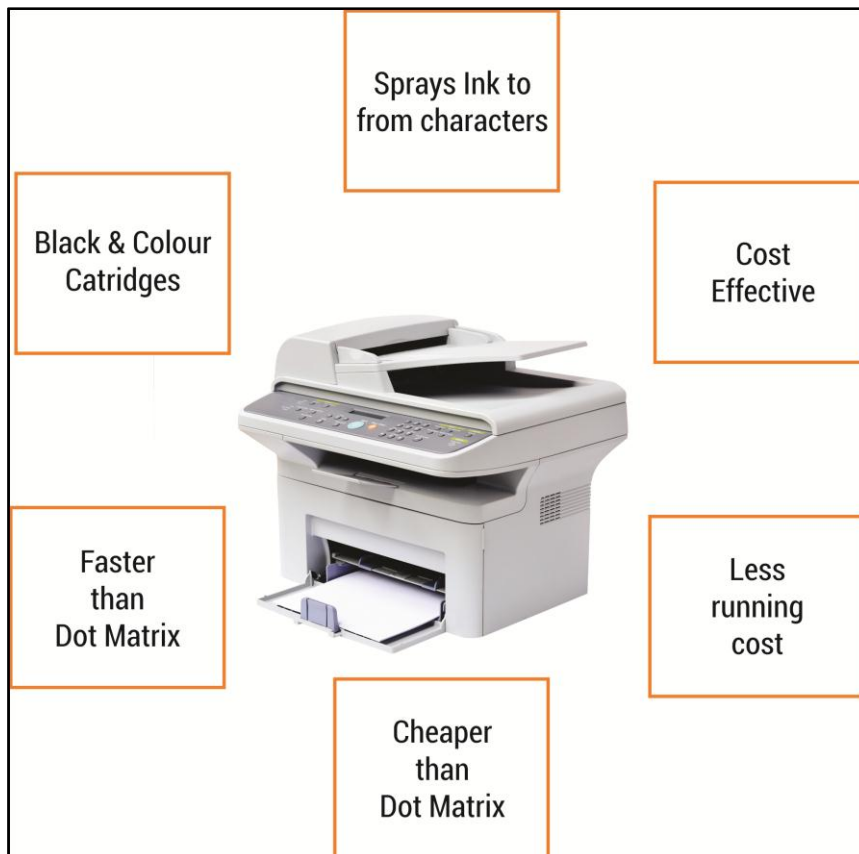

Fig. 2.10 Features of Ink Jet Printer

Laser Printer

Laser Printers use a combination of laser and copying technology to make copies. Laser printer prints clear copies as compared to other printers, and operates very fast.

Fig. 2.11 Laser Printer

They use a toner which is filled with power ink. The toner sprays the powder and the fuser on heating dried powder. They are quite expensive and heavy. They have excellent printing quality.
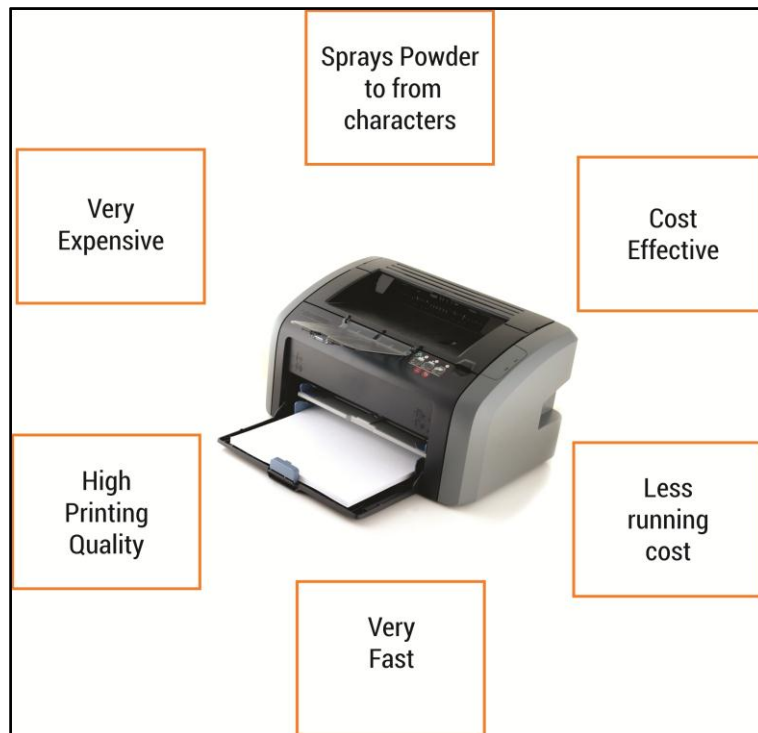

Fig. 2.12 Features of Laser Printer

Laser Printers are of two types:

1.   Colour Laser Printer

2.   Black and White Laser Printer

Check your progress 6

1.   _____printer uses ink cartridges to print

    a. Dot Matrix printer   c. Line printer

    b. Inkjet printer   d. Laser Printer

2.   Laser Printer uses:

    a. Ribbon cartridge   c. Powder Ink

    b. Liquid ink cartridge   d. Gas cartridge

2.8   Let Us Sum Up

In this unit, we have learned:

- Light Pen and Digital Camera are input devices, Digi Cam or Digital Camera is used to store digital Images.

- Printers are available in three types as: Dot Matrix, Ink Jet and Laser, Ink Jet printer uses liquid ink and Laser printer uses powder ink.

- There are two types of Storage Devices: Optical Storage and Magnetic Storage, Magnetic Storage Device is Hard Disk and Optical Storage Device is CDs and DVDs, Hard Disk is the main storage media inside the Computer System.

- CD ROM also called as Compact Disc Read Only Memory is used for recording information's.

- CD-RW is a Compact Disk Rewritable where you can store and delete information any time.

- The data can be stored and deleted from a Pen drive.

2.9   Answers for Check Your Progress

Check your progress 1

Answers: (1-b), (2-a), (3-c)

Check your progress 2

Answers: (1-d), (2-a)

Check your progress 3

Answers: (1-d)

Check your progress 4

Answers: (1-c), (2-c)

Check your progress 5

Answers: (1-d)

Check your progress 6

Answers: (1-b), (2-c)

2.10   Glossary

1. **Printer -** It is an output device used for printing documents.

2. **Hard Disk -** It is a storage media used directly on the computer.

3. **CD ROM -** It is Compact Disc Read Only Memory which is used for recording information.

4. **CD-RW -** it is Compact Disk Rewritable to store and re-write any information anytime.

5. **Pen Drive -** It is a portable storage media.

2.11 Assignment

Explain the different type of Printers used today with examples?

2.12 Activities

Take the print of your document from two printers and compare.

2.13 Case Study

Will data on CD or DVD store at the same speed and with same size.

2.14 Further Readings

1.   Fundamental of information Technology by Er. NishitMathur

2.   Introduction to Computer Networking by Paul G Ranky

Block Summary

In this block, the readers were given knowledge about basic networking features and its associated tools. The usability of modem along with other networking device will help students to really know about the concept of connecting computer to web. The basic understanding of external and internal storage devices like Hard Disks, CD's, DVDs and USB drives will makes the user aware about how they can store their data for longer use.

After reading this block, readers were given with an insight characteristics and features of internal and external storage with their application in daily life. Students after completing this block can work with various types of printers as per their requirements.

Block Assignment

Short Answer Questions

1. What do you mean by Input/output devices?

2. State the Advantages and Disadvantages of a pen drive?

3. Write the applications of a Digital Camera?

4. What is a Digital Camera?

5. What is a CD ROM?

Long Answer Questions

1. Write the functions of a laser printer?

2. How does the CD ROM write data on CD?

3. What are the advantages of Digital Camera over a standard Camera?

Enrolment No.

1. How many hours did you need for studying the units?

Unit No	1	2	3	4
Nos of Hrs				

2. Please give your reactions to the following items based on your reading of the block:

Items	Excellent	Very Good	Good	Poor	Give specific example if any
Presentation Quality	☐	☐	☐	☐	____ ____
Language and Style	☐	☐	☐	☐	____ ____
Illustration used (Diagram, tables etc)	☐	☐	☐	☐	____ ____
Conceptual Clarity	☐	☐	☐	☐	____ ____
Check your progress Quest	☐	☐	☐	☐	____ ____
Feed back to CYP Question	☐	☐	☐	☐	____ ____

3. Any Other Comments.

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*Education is something
which ought to be
brought within
the reach of every one.*

"

- Dr. B. R. Ambedkar

Dr. Babasaheb Ambedkar Open University
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Ahmedabad-382 481.