

Chapter – 1

Basic Components of a digital Computer

1.1 Introduction

Recent Advanced research by microelectronics research society, Computer is an essential part of our society. Each day of our lives are start with digital alarm clock or mobile, drive car or any other vehicle in digital processor controlled automobiles and speedometers .work in extensively automated offices. in market all prices are tagged with a digital system which can store the product information and price of the product. Computer is used in every productive and non productive field. A great majority of the computers of our daily use are known as general purpose machines, other are special purpose machines is an important for solve a specific task, i.e. scientist use machine for reducing the complexity of their research work.

Computer is a combination of electronics and mechanical, so it is an electro mechanical device. The technological revolution witnessed in the computer industry is the result of a long chain of enormous and successful efforts made by two major forces. These are the academia, and the industry, represented by computer companies. This chapter describing the architecture of general purpose digital computer system.

1.2 Computer System Architecture

Basic function of computer is process data input by user and output or store the result of the processed data, for better used in specific application, so computer architecture is divided in four part input, output control and storage.

For example, controlling the room temperature system sensor sense the current room temperature, this is input of the system. Control temperature is output of system and if the temperature is set at 18 degree centigrade for lowest, system sensor control the compressor and turn off the compressor when room temperature is 18, it is the control part of system.

The computer revolution continues. Each time the cost of computing improves by another factor of 10, the opportunities for computers multiply. Applications that were economically infeasible suddenly become practical. In the recent past, the following applications were "computer science fiction."

- **Automatic teller machines:** A computer placed in the wall of banks to distribute and collect cash would have been a ridiculous concept in the 1950s, when the cheapest computer cost at least \$500,000 and was the size of a car.
- **Computers in automobiles:** Until microprocessors improved dramatically in price and performance in the early 1980s, computer control of cars was ludicrous. Today,

computers reduce pollution and improve fuel efficiency via engine controls and increase safety through the prevention of dangerous skids and through the inflation of air bags to protect occupants in a crash.

- **Laptop computers:** Who would have dreamed that advances in computer systems would lead to laptop computers, allowing students to bring computers to coffeehouses and on airplanes?

- **Human genome project:** The cost of computer equipment to map and analyze human DNA sequences is hundreds of millions of dollars. It's unlikely that anyone would have considered this project had the computer costs been 10 to 100 times higher, as they would have been 10 to 20 years ago.

- **World Wide Web:** Not in existence at the time of the first edition of this book, the World Wide Web has transformed our society. Among its uses are distributing news, sending flowers, buying from online catalogues, taking electronic tours to help pick vacation spots, finding others who share your esoteric interests, and even more mundane topics like finding the lecture notes of the authors of your textbooks.

General purpose computer is a supplementary combination of Hardware and Software. There are two basic components of computer system architecture

(A) Computer Hardware.

(B) Computer Software.

A. Computer Hardware

All above application of computers are use special purpose computer hardware, which contains less hardware components, General purpose computer containing a four basic hardware blocks which are memory unit (MU), arithmetic and logic unit (ALU), input/output unit (IOU), and control unit (CU). Input/output (I/O) devices input and output data into and out of the memory unit. In some systems, I/O devices send and receive data into and from the ALU rather than the MU. Programs reside in the memory unit. The ALU processes the data taken from the memory unit (or the ALU) and stores the processed data back in the memory unit (or the ALU). The control unit coordinates the activities of the other three units. It retrieves instructions from programs resident in the MU, decodes these instructions, and directs the ALU to perform corresponding processing steps. It also oversees I/O operations.

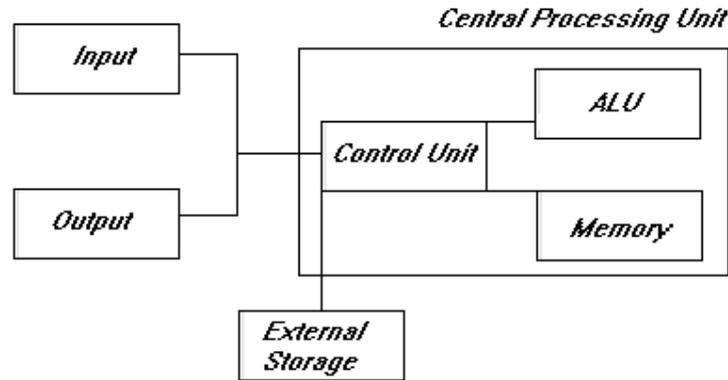


Fig. 1.1 Computer Hardware Architecture

1. **I/O Unit:** The input unit contains the hardware devices those are used to enter the data in to computer system, Keyboard and mouse are most common devices. The out put contain the hardware devices those are use to output the data from the computer system, Monitor and printer are most common output devices. Nowadays so many other I/O devices are shown in Fig 1.2.

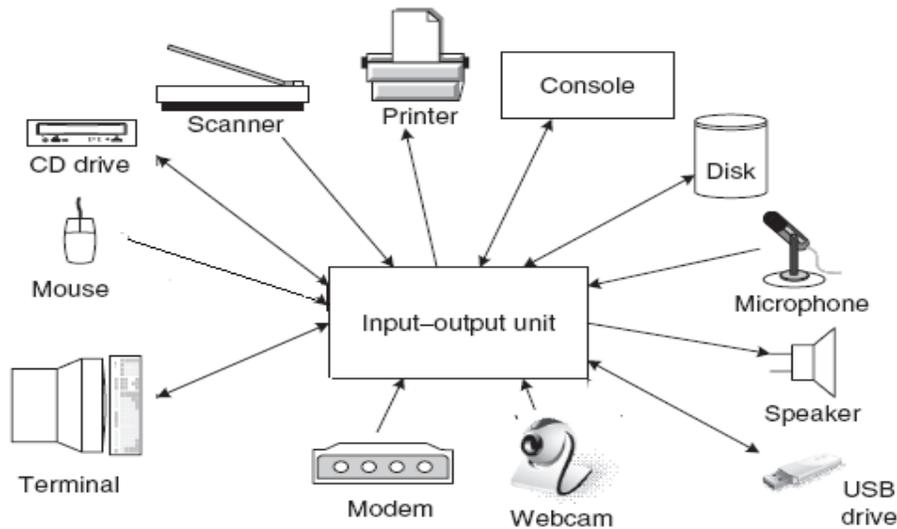


Fig. 1.2 Input Output Devices

2. **Control Unit:** The control unit maintains the sequence of the operation, controlling the actions of all other units it can perform the instruction which constitute the program and direct as per the operation perform by machine.
3. **Arithmetic and logic Unit:** The ALU unit functions are perform arithmetical operation, i.e. addition, subtraction, multiplication, division as well as logical operation i.e. and, or, not.

The control unit gives the instruction to the ALU which operations they have to perform and where it supplied (store purpose), it is directed to perform the operations.

4. **Memory Unit:** The memory unit or storage section of the computer consist the devices used to store the data or information during the process. Memory unit is used to hold intermediate and final result of computer program. There are various types of memory which are used in computer system are as below. In this memory structure importance of the memory as per top to down approach in *Fig 1.3*.

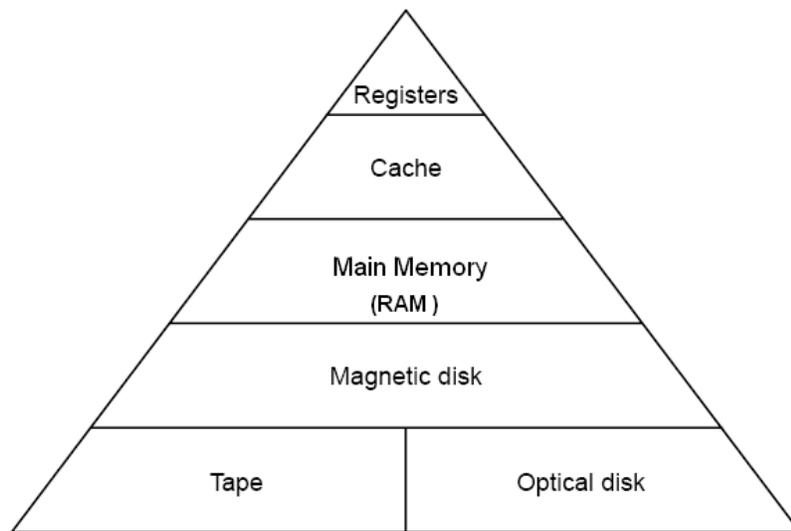


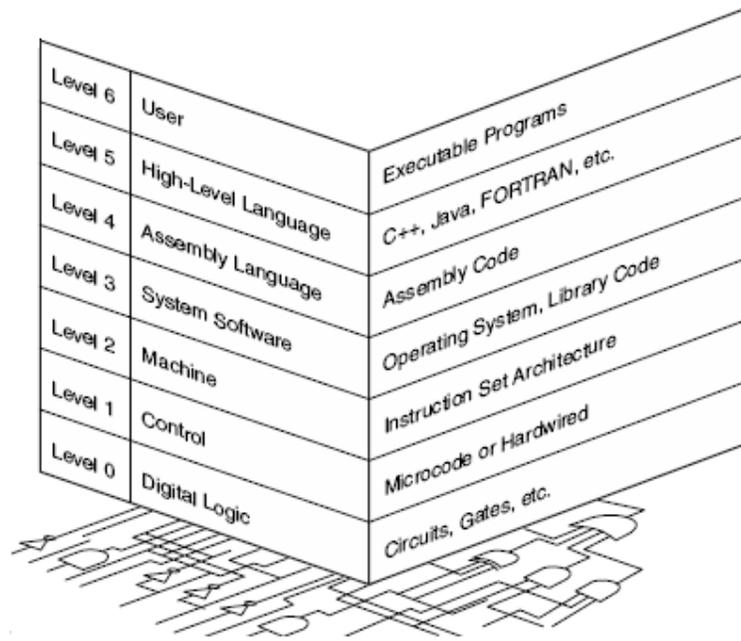
FIG 1.3 Memory Hierarchy

B. Computer Software:

If a machine is to be capable of solving a wide range of problems, it must be able to execute programs written in different high level languages, like 'C' or 'C++', while a the only physical components we have to work with are wires and gates. There is a difficult gap between these physical components and high level languages. For a system to be practical, the semantic gap must be invisible to most of the users of the system.

As per the practical rules that if the problem is large then it should be break it down and use "divide and conquer" thoughts. In programming approach, we divide a problem into modules and then design each module separately. Each module performs a specific task and modules need only know how to interface with other modules to make use of them.

Computer system organization can be approached in hierarchy of levels, in which each level has a specific function and exists as a distinct hypothetical machine. By studying computer organization, these layers are implemented and interface with each other.



1.4 General purpose Computing System

Level 6, User Level: is composed of applications and is the level with which everyone is most familiar. At this level, we run programs such as word processors, graphics packages, or games. The lower levels are nearly invisible from the User Level.

Level 5, the High-Level Language: Programming languages such as C, C++, FORTRAN, Lisp, Pascal, and Prolog consisting of this level. These languages must be translated (using either a compiler or an interpreter) to a language the machine can understand. Compiled languages are translated into assembly language and then assembled into machine code. (They are translated to the next lower level.) The user at this level sees very little of the lower levels. Even though a programmer must know about data types and the instructions available for those types, she need not know about how those types are actually implemented.

Level 4, the Assembly Language: As earlier mentioned, compiled higher-level languages are first converted to assembly, which is directly translated to machine language. This is a one-to-one translation, meaning that one assembly language instruction is translated to exactly one machine language instruction. By having separate levels, we reduce the semantic gap between a high-level language, such as C++, and the actual machine language (which consists of 0s and 1s).

Level 3, the System Software: deals with operating system instructions. This level is responsible for multiprogramming, protecting memory, synchronizing processes, and various other important functions. Often, instructions translated from assembly language to machine language are passed through this level unmodified.

Level 2, the Instruction Set Architecture (ISA), or Machine Level: consists of the machine language recognized by the particular architecture of the computer system. Programs written in a computer's true machine language on a hardwired computer (see below) can be executed directly by the electronic circuits without any interpreters, translators, or compilers.

Level 1, the Control level: control unit makes sure that instructions are decoded and executed properly and that data is moved where and when it should be. The control unit interprets the machine instructions passed to it, one at a time, from the level above, causing the required actions to take place. Control units can be designed in one of two ways: They can be *hardwired* or they can be *micro programmed*.

Level 0, the Digital Logic Level: physical components of the computer system: the gates and wires. These are the fundamental building blocks, the implementations of the mathematical logic that are common to all computer systems.

Summary:

Electronics computer are newest but the technology behind the historical development in the last sixty years, in these chapter we are only concentrated the architecture of general purpose computer system because of our syllabus but more architectural study is RISC, and CISC. We will study Memory Organization, ALU, CPU, and I/O Organization in depth.