Yayu Education of India

8086 MICROPROCESSOR & INTERFACING AND OTHERS

Arun Rana

8086-MICROPROCESSOR
&
INTERFACING AND OTHERS

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&
INTERFACING AND OTHERS

for
(Electronics & Communication Engg., Electrical Engg., Computer Engg., Information Tech. & Instrumentation Engg.)

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Second Edition

AN ISO 9001:2008 CERTIFIED COMPANY
VAYU EDUCATION OF INDIA
2/25, Ansari Road, Darya Ganj, New Delhi-110 002

8086-MICROPROCESSOR AND INTERFACING AND OTHERS

ISBN: 978-93-80097-28-2

First Edition: 2010
Second Edition: 2013

Price: ₹ 350/-

Printed & bound in India

Published by:

AN ISO 9001:2008 CERTIFIED COMPANY

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Dedicated to

My respectable parents, my brothers, my sister, my bhabhi ji
and
Lovely nephew, Aakash Rana

Acknowledgment

We being the teachers of Microprocessor & Interfacing communicated with the students and found that they were facing problem regarding the complete syllabus in a single book. While teaching we kept on prepairing covering syllabus, typical problems, experiments and solution to the University paper which were continuously appreciated by the students. So I planned toconvert these notes in form of a book on Microprocessor & Interfacing. If you have decide to read this book, then you have decide to learn about one of the most exciting, challenging, and rapidly advancing field in technology. This is the field which is known as by several names, some of them being: microprocessor based design, microprocessor architecture, electronic & the simplest one being microprocessor. The aim of the book is to deal with microprocessor, their interfacing, supporting chips, interfacing circuits and devices, peripherals etc. It includes assembly language programming of Intel 8085. This book is very useful to B.Tech/Diploma. The book is written for the first course of microprocessor, which is in the curriculum of B.Tech, Diploma.

With the advent of the first 4 bit microprocessor 4004 from Intel Corporation in 1971, there has been a silent revolution in the domain of digital system deigns, which has shaken many facets of the current technological progress. In the last 28 years the world has seen an evolution of microprocessors, whose impact on today's technological scenario is phenomenal. This evolution was possible because of the tremendous advance in the semiconductor process technology. The first microprocessor 4004 contained only ten thousand transistor while the component density increase more than threefold in less than a decide time. Immediately after the introduction of the 4004, the Intel introduces the first 8-bit microprocessor 8008 in 1972: these microprocessors were, however not successful because their inherent limitation. The first 8-bit functionally complete CPU 8085 was introduced in 1977.

The first 16 bit CPU from Intel was a result of the designer efforts to produce a more powerful and efficient computing machine. The designer of 8086 CPU had taken note of the major limitation of the previous generation of the 8 bit CPU. The 8086 contain set of 16-bit general purpose register, support a 16 bit ALU, a rich instruction set and provide segmented memory addressing scheme. The entire feature made this 16 bit processor a more efficient CPU. This book is intended as a textbook on microprocessor and its application' which is compulsory curse at graduate and diploma level in many science and engineering branches of the studies, specially in Electronics, Electrical, Instrumentation, Physics and Computer engineering discipline.

BOOK AIMS

1. To introduce the microprocessor as a programmable digital system element.
2. To provide an understanding of a microprocessor based system as a combination of hardware and software subsystem and their interaction.
3. To illustrate some basic concept of microprocessor through the use of assembly language programming.
4. To outline the principle of microprocessor development system.

ARUN RANA

Preface to the First Edition

I take this opportunity to express my gratitude and thanks to respected Dr. A.K. Garg, HOD of ECE Deptt. in MMEC, Mullana for his valuable technical suggestions and constant encouragement, without which this book would not have come into existence.

I am specially gratefull to Mr. Prabh Deep Singh and Mr. Ravinder Singh Bisht, Assistant prof. of Deptt. of Electronics and comm. Engineering, RPIIT, Bastada, Karnal for his time to time, much needed valuable guidance.

I am grateful to my younger brothers Ajay Singh Rana and Tushil Rana, for inspiring me further project.

I would like to express my sincers thanks to Mr. Sumit Rana, Mr. Balvinder Singh, Mr. Sanjeev Dhiman, Mr. Sanjeev Bawa, Mr. Gurudev Singh, Mr. Ashish Chopra, Mr. Hitesh Kapoor, Mr. Sandeep Jain, Mr. Prikshit, Mr. Mohit, Mr. Kapil Arora, Mr. Swati Gupta,Ms. Getika Dua, Ms. Nidhi Uppal, Ms. Nidhi Mittal, Ms. Neha, Ms. Ritu Chabbra for constant inspiration and encouragement.

I deeply express my heartful thanks to the publishers Vayu Education of India for publishing this Book in such a beautiful get-up and well in time.

ARUN RANA

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Chapter

1

Fundamental of Computer

OBJECTIVE: After completing this chapter, the reader should be able to:

- History
- Introduction of Microprocessor
- Micro Computer
- Computer Languages
- Embedded System

1.1 HISTORY

The microprocessor is the combination of solid-state technology development and the advancing computer technologies which came together in the early 1970s. With the low cost of a device and the flexibility of a computer, microprocessor is a product which performs both control and processing functions.

A brief history

The microprocessor of two major technologies; digital computer and solid-state circuits. These two technologies came together in the early 1970s, allowing engineers to produce the microprocessor.

The digital computer is a set of digital circuit controlled by a program that makes it do the job you want done. The program tells the digital how to move process data. It

does this by using the digital computer's calculating logic, memory circuits, and I/O devices. The way, the digital computer's logic circuits are put together to build the calculating logic, memory circuits and I/O devices is called its architecture.

The microprocessor is like the digital computer because both do computations under programming control.

During World War II, scientists developed computers for military use. The latter half of the 1994s, digital computer was developed to do scientific and business work, Electronic circuit technology also advanced during World War II. Radar work increased the understanding of fast digital circuits called pulse circuits. After the war, scientists made great progress in solid-state physics. Scientists at Bell Laboratories invented the transistor, a solid-state device, in 1948.

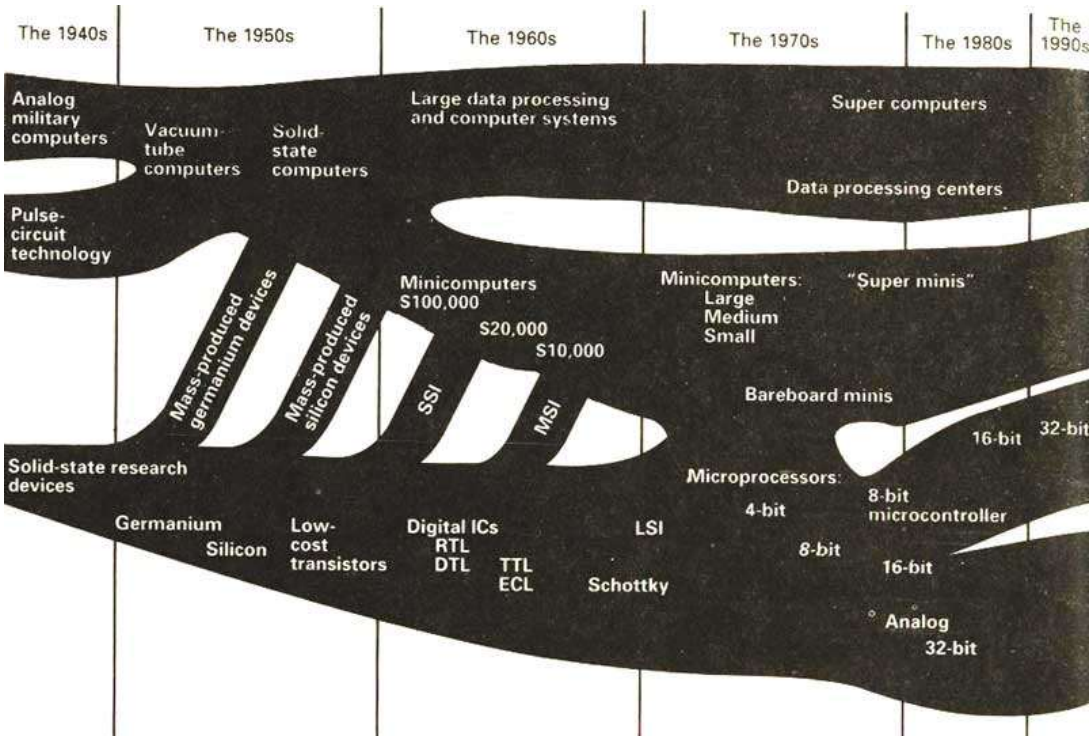


Fig. 1.1: Shows the major events in the two technologies as they developed over the last five decades from the days of World War II.

In the early 1950s, the first general-purpose digital computer appeared. Vacuum tubes were used for active electronic components. They were used to build basic logic circuits such as gates and flip-flops. Vacuum tubes also formed part of the machines built to communicate with the computer – the I/O (input/output) devices. The first digital computers were huge, because the vacuum tubes were hot and required air-conditioning.

Vacuum tubes made the early computer expensive to run and maintain. Solid-state circuit technology also made great strides during the 1950s. The knowledge of semiconductors increased. The use of silicon lowered costs, because silicon is much more plentiful than germanium, which had been the chief material for making the early semiconductors. Mass production methods made transistors common and inexpensive.

In the late 1950s, the designers of digital computers jumped at the chance to replace vacuum tubes with transistors.

In the early 1960s, the art of building solid-state computers was divided in two directions. The first direction was building huge solid-state computer by IBM. IT still required large, air-conditioned rooms and very complicated. IT could process large amounts of data. These large data processing systems were used for commercial and scientific application.

The big computer was still very expensive. In order to pay for it had to be run 24 hours a day, 7 days a week. Another direction of development is began building small computers. These minicomputers were not as powerful as their larger relatives, but they were not as expensive either. And they still performed many useful functions. By the early 1960s, the semiconductor industry found a way to put a number of transistors on one silicon wafer. The transistors are connected together with small metal traces. When the transistors are connected together, they become a circuit which performs a function, such as a gate, flip-flop, register, or adder. This new technology created basic semiconductor building blocks. The building blocks or circuit modules made this way are called an integrated circuit (IC).

By the mid-1960s, the technology of ICs pushed to develop low-cost manufacturing techniques. The use of ICs let minicomputers become more and more powerful for their size. The desk-sized minicomputers of the 1960s became as powerful as a room-sized computer of the late 1950s. Now $10,000, drawer-sized minicomputers were as powerful as the older $100,000.

The late 1960s and early 1970, large-scale integration (LSI) become common. Large-scale integration was making it possible to produce more and more digital circuits in a single IC.

By the 1980s, very large-scale integration (VLSI) gave us ICs with over 100,000 transistors. By the mid 1970s, LSI had reduced the calculator to a single circuit. After the calculator was reducing, the next natural step was to reduce the architecture of the computer to a single IC. The microprocessor was the resulting circuit of achievement. The microprocessor made possible the manufacture of powerful calculators and many other products. Microprocessor could be programmed to carry out a <1 single task> Products like microwave ovens, telephone dialers and automatic temperature-control systems become common place.

The early microprocessor processed digital data 4 bits (4 binary digits) at a time. These microprocessors were slow and did not compare to minicomputers. But new generations of microprocessors came fast. The 4 bit microprocessors grew into 8 bit microprocessors, then into 16 bit microprocessors, and then into 32 bit microprocessors. During the early

1980s, complete 8 bit microprocessor systems (microprocessors with memory and communications ability) were developed. These microcontrollers, or single-chip microprocessors, have become popular as the basis of controllers for keyboards, VCRs, TVs, microwave ovens, smart telephones, and a host of other industrial and consumer electronic devices.

1.2 WHAT IS A MICROPROCESSOR?

The microprocessor uses the same type of logic that is used in a digital computer's central processing unit (CPU). Because it is similar to the CPU and it is constructed with microcircuit (IC) technology. The microprocessor has digital circuit for data handling and computation under program control. (The microprocessor is a data processing unit) Data processing is the microprocessor's main function. Data processing includes both computation and data handling. Computation is performed by logic circuits that make up what is usually called the arithmetic logic unit (ALU). These logic circuits enable us to use functions that cause data changes. Among these functions are Add, Subtract, AND, OR, XOR, Compare, Increment and Decrement. The ALU cannot perform any of these functions with out data operation on. In order to process data, the microprocessor must have control logic which tells the microprocessor how to decode and execute the program.

Program is a set of instructions for processing the data

The control logic steps the microprocessors through the stored program steps (instructions) in memory. It calls (fetches) them one at a time. After the instruction is fetched, the microprocessor's control logic decodes the instruction. Then the control logic carries out (executes) the decoded instruction. Because the instructions are stored in memory, you can change them when you want to.

Review: The microprocessor's purpose is to process data. To do this, it must have logic to process and handle data, and control logic. The processing logic moves data from place and performs operations on the data.

Microprocessor is a multipurpose, programmable, clock-driven, register-base, electronic device that reads binary instructions from a storage device called memory, accepts binary data as input and processes data according to those instructions, and provides results as output.

1.3 CLASSIFICATION OF COMPUTER

Computers can be generally classified by size and power as follows, though there is considerable overlap:

- **Personal Computer:** A small, single-user computer based on a microprocessor.

  In addition to the microprocessor, a personal computer has a keyboard for entering data, a monitor for displaying information, and a storage device for saving data.
- **Working Station:** A powerful, single-user computer. A workstation is like a

personal computer, but it has a more powerful microprocessor and a higher-quality monitor.

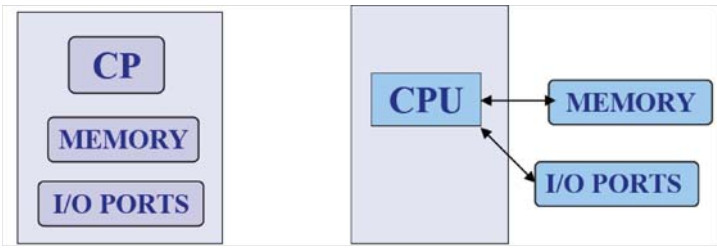
- **Minicomputer:** A multi-user computer capable of supporting from ten to hundreds of users simultaneously.
- **Mainframe:** A powerful multi-user computer capable of supporting many hundreds or thousands of users simultaneously.
- **Supercomputer:** An extremely fast computer that can perform hundreds of millions of instructions per second.

1.4 EMBEDDED SYSTEM

A specialized computer system that is part of a larger system or machine.

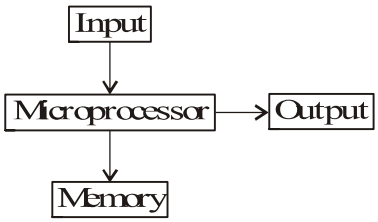
- Typically, an embedded system is housed on a single microprocessor board with the programs stored in ROM.
- Virtually all appliances that have a digital Interface- watches, microwaves, VCRs, cars -utilize embedded systems.
- Some embedded systems include an operating system, but many are so specialized that the entire logic can be implemented as a single program.

MICRO CONTROLLER	MICRO PROCESSER
• It is a single chip • Consists Memory, I/o ports	• It is a CPU • Memory, I/O Ports to be connected externally

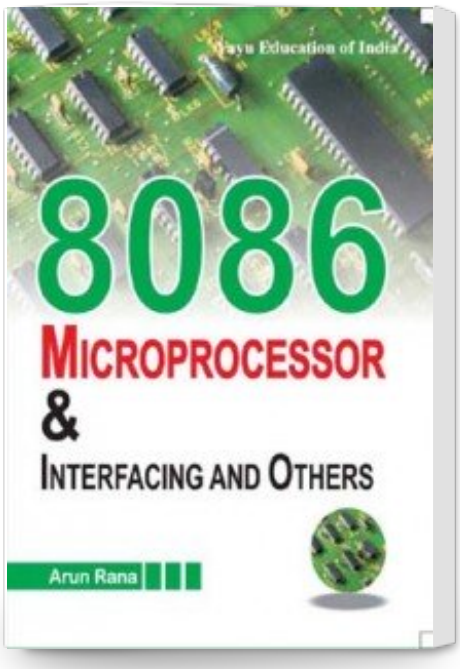


Microcontroller **Microprocessor**

1.5 FOUR COMPONENTS OF MICROPROCESSOR



8086 Microprocessor and Interfacing and Others



Publisher : Vayu Education ISBN : 9789380097282 Author : Arun Rana