

Microcomputer Development System

11.1 Introduction

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- The microprocessor based systems are used in industries for a variety of applications such as equipment control, level control, process control, temperature monitoring system etc. These systems do not have large memories and peripherals. They do not have compilers, debuggers, floppy disk system, hard-disk, CRT provided with them.
- The microprocessor based system forms the part of the equipment that needs to be controlled. Also, with the addition of software the overall cost of the system increases.
- But in laboratories where the microprocessor based systems are developed and designed, the programmer needs the peripherals and their software supports. For this purposes, a special equipment called as **Microcomputer Development System (MDS)** is used. It has peripherals, large memory, mass storage system, debugging facilities, printers etc.
- The design of a microcomputer development system is modules. It may consist of hardware and software devices. The hardware devices in the MDS are CPU, Memory, consisting of RAM and ROM, CRT Display, Emulator, ROM simulator, PROM programmer etc. The software support that may be available in an MDS system are operating system, monitor, text editor, assembler, compiler.
- Intel MDS of service IV provide facilities for 8 bit as well as 16 bit microprocessors. It consists of compilers for PASCAL, FORTRAN and PL/M.
- **Philips MDS** : The MDS manufactured by Philips are PM 4421 and 4422. PM4421 consists of monitor, editor, assembler, compilers for FORTRAN, BASIC and PASCAL, debugger, linker, PROM programmer and a number of software packages etc. It contains a 16-bit CPU, printer, CRT, in-circuit emulator, magnetic disk etc.
- PM 4422 is an advanced version of PM 4421. It is designed for multi-users.
- The MDS are suitable for development of most of the 8-bit and 16-bit microprocessor based systems.

11.2 PROM Programmer

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- PROM means programmable read only memory. The name itself suggests that it is a programmable ROM. The user can write the programs that the permanently requires in a PROM. The equipment that is used for programming the PROM is called as the PROM programmer.
- An EPROM is an erasable PROM. The equipment that is used for programming the EPROM is called as the EPROM programmer.
- The microprocessor kits that have PROM/EPROM programming facilities. These kits are manufactured by Vinytics; Professional Vinytics manufactures VMC-8516 kit. The EPROM 2716 and 2732 can be programmed on the kit.

- Universal PROM programmers are supplied by the manufacturer, with the advent of microcomputer development system.
- The PROMs/EPROMs that are supported by the system only can be programmed by the universal PROM programmer. In case the PROM/EPROM is not supported by the system, additional modules need to be developed so that they can be used with the universal PROM programmer. The universal PROM programmer costs approximately Rs. 10,000.
- The Vinytics manufactured PROM programmer can be used for programming the 2716, 2732, 2732 A, 2764, 27128, 2532, 8755 etc.
- The Professional manufactured PROM programmer can be used for programming 2708, 2716, 2732, 2732 A, 8748, 8755, 8741 and 48016 by the personality module PM 8102, 2716, 2532, 2732, 2732 A, 2764, 27128, 48016, 2815 and 2816 by PM 8104.
- It also supports ROM emulation facility.

11.3 EPROM Erasers

- An EPROM is an erasable PROM. The data on the EPROM can be erased by exposing it to high intensity short wave ultraviolet light of 2537 Å for 10 to 20 minutes.
- An EPROM eraser has a UV tube of 2537 Å. It has an inbuilt timer of 60 minutes. It also provides auto shut off facility. When the set time is over, the tray is pulled out and the timer automatically switches off the UV tube.
- In order of set the time depending on the type of EPROM to be erased, a spring loaded timer is provided.
- The timer switches off the light source after the preset time period.
- The EPROM eraser needs 230 V AC \pm 10% supply for its operation. At a time, number of EPROMs can be erased. A professional EPROM eraser can erase upto 8 EPROMs at a time.
- The power consumption of the eraser is low, about 10 W.

11.4 Emulator

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- The emulator is used to test and debug the hardware and software of an external system such as the Microcontroller based system.
- Emulator is a combination of hardware and software.
- An emulator consists of a multi-wire cable that connects the host system to the external system.
- Through this cable the software of the emulator allows the user to download the object code program into RAM in the external system being developed.
- Like the debugger the emulator also allows the user to load the programs to be tested, run the programs check and modify the contents of various registers and memory locations and also insert the breakpoints.
- As each instruction in the assembly language program is executed, the emulator as if takes "snapshot" of the register contents, activities on the address and data buses and the state of flag register.
- The emulator stores this data as "trace data".
- It is possible to take out the print out of the trace data so as to analyse the results produced in the program on the step by step basis.

11.4.1 An In-circuit Emulator

- An in-circuit emulator (ICE) is a hardware device used during the development of microprocessor based / microcontroller based systems. Virtually all such systems have a hardware element and a software element, which are separate but highly interdependent.

- The ICE allows the software element to be run and tested on the actual hardware on which it is to run, but still allows programmer conveniences such as source-level debugging and single-stepping, etc.
- Without an ICE, the development of microprocessor / microcontroller based systems can be extremely difficult, since if something does not function correctly, it is often very hard to tell what went wrong without some sort of monitoring system to oversee it.
- Most ICEs consist of an adaptor unit that sits between the host computer and the system to be tested. A large header and cable assembly connects this unit to where the actual CPU or microcontroller mounts within the system to be tested.
- The unit emulates the CPU, such that from the system's point of view, it has a real processor fitted. From the host computer's point of view, the system under test is under full control, allowing the developer to debug and test code directly.
- The emulator is used to test RAM, I/O ports and control functions of the development system by replacing the microprocessor IC on the board by the in-circuit emulator. E.g. with the help of the in-circuit emulator a user could stop in between during the execution of a program for examining the contents of memory locations and registers. This helps the user to see the intermediate results obtained at a particular condition, by which the user can come to know why the hardware is not performing upto the expectations.
- The 8085 in-circuit emulator stores 4 bytes of data after the execution of each machine cycle.
- The four bytes stored are status, address high byte, address lower byte and data byte. These 4 bytes are also called as **snap data**. They can be read out or printed to trace the program flow on the data and address bus.
- In 8085 in-circuit emulator the snap data for previous 44 machine cycles before which a breakpoint has not occurred is saved in the trace RAM.
- Whenever a program is executed to a breakpoint, it enters the interrogation mode. The in-circuit emulator allows the user to display or point the memory contents, flags, register contents, signals of the 8085.
- The 8085 in-circuit emulator provides single-stepping, through which user can execute one instruction at a time to monitor the contents of registers, flags and memory location after execution of instruction.
- Some MDS have the facility for multi-processor emulation e.g. PM 4422 system of Philips can support upto 4 microprocessors. This approach provides considerable savings in time compared with attempts to debug each microprocessor individually. With synchronized or inter-related breakpoints and a real-time trace facility, the interactions of all microprocessors in the target system can be monitored. This provides a complete picture of the overall system performance.

11.5 Simulator

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- A **Simulator** is often used to execute a program that has to run on some inconvenient type of computer. For example, simulators are usually used to debug a microprogram.
- Since the operation of the computer is simulated, all of the information about the computer's operation is directly available to the programmer, and the speed and execution of the simulation can be varied as per the user's wish.
- Simulators may also be used to interpret **fault trees**, or test logic designs before they are constructed.
- Many video games are also simulators, that are implemented inexpensively.
- Simulator is a software package that functions like a hardware without acquiring hardware. The 8051 microcontroller simulator gives the user an 8051 environment on the PC
- It performs the functions of the 8051 microcontroller / 8085 microprocessor without using it.
- It also performs a simulation of different peripherals that are used with the microcontroller / microprocessor in any application
- It provides facilities that help the user to find logical errors, facilities to help the user learn about the initialization of different peripherals and get an insight of the microcontroller functioning.
- It does acts as a direct replacement of the costly 8051 microcontroller kit.