Harman Microcontrollers 3 VIEWS CENG 5434

Harman CPU clock, memory, data bus, addressing

Several parameters serve to differentiate microprocessors and microcontrollers as shown in the Table. For the microcontrollers, the table would refer to the CPU and its internal memories. Modules will be considered later. The microprocessor with external memory is defined as shown in the Table.

Type	*Support*
CPU	Generally defined by normal data size -8-,16-,or 32-bits
Clock speed	Determines the speed-of-operation of CPU only
Memory Unit(s)	Size and type determine program and data storage sizes.
Addressing range	For internal or external memory, determines maximum size.
Data Bus size	Number of bytes that can be processed at once.
	Operand length is often determined by this.
I/O modules	External to CPU

Table 1: Characteristics of CPUs

2.1 MICROCOMPUTER ORGANIZATION AND BUS STRUCTURE

The elements of a simple microcomputer are shown in Figure 2.1. This block diagram shows the microprocessor (CPU), a memory unit, and I/O circuitry. The CPU communicates with its memory and interface circuits via parallel signal lines which, taken together, constitute the internal bus. Using parallel signal lines, each signal line may be used simultaneously with and independently of the others to transfer electrical signals representing information. Thus, 16 data signal lines would allow the simultaneous transfer of 16 bits. In contrast, a serial data line would require 16 transfers of one bit at a time to accomplish the same thing.

In Figure 2.1, the internal bus is shown separated functionally into *address* signal lines, *data* signal lines, and *control* signal lines. For simplicity when discussing only

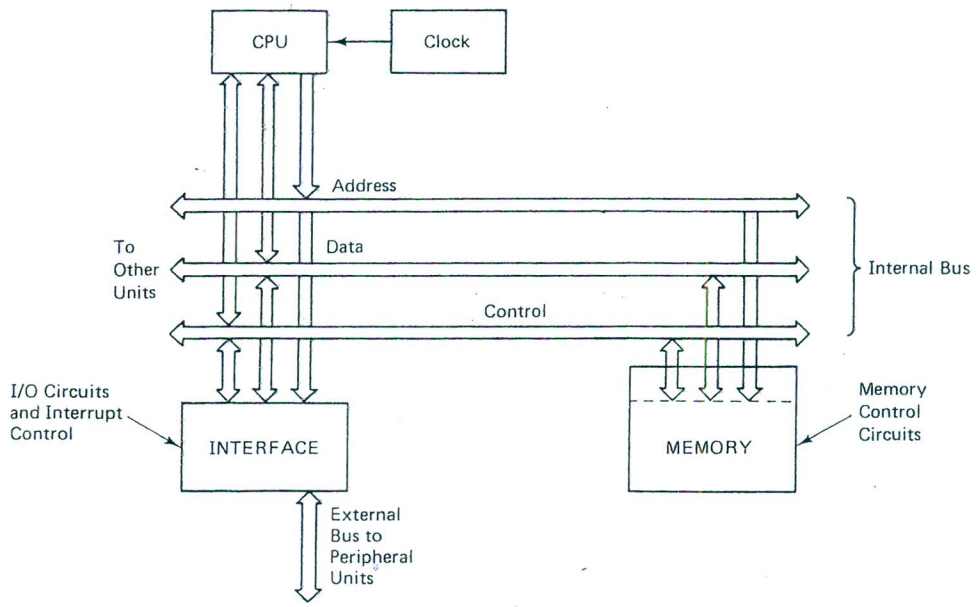


Figure 2.1 Simplified microcomputer organization.

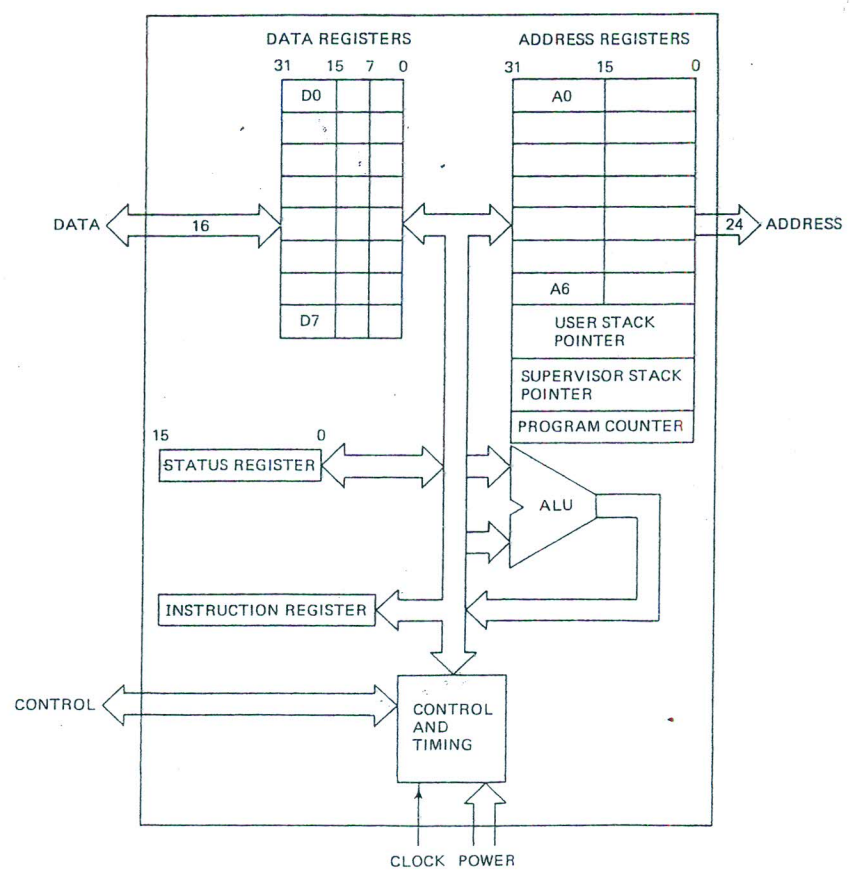


Figure 4.1 The MC68000 register set and transfer paths.

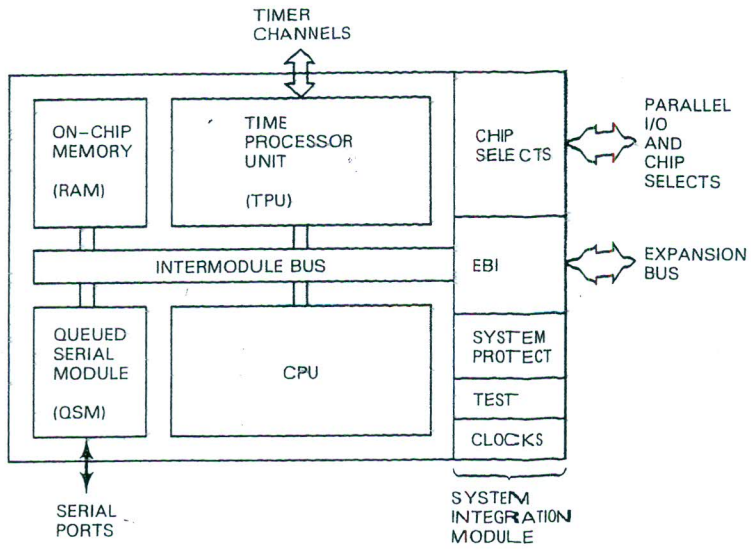


Figure 2.3 Modules of the MC68332.

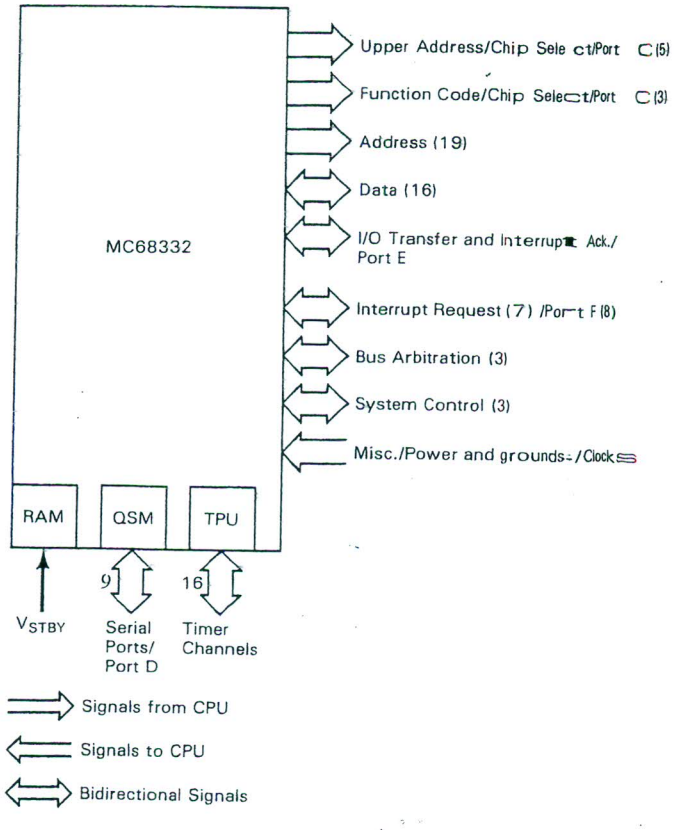


Figure 2.20 Signal lines of the MC68332.

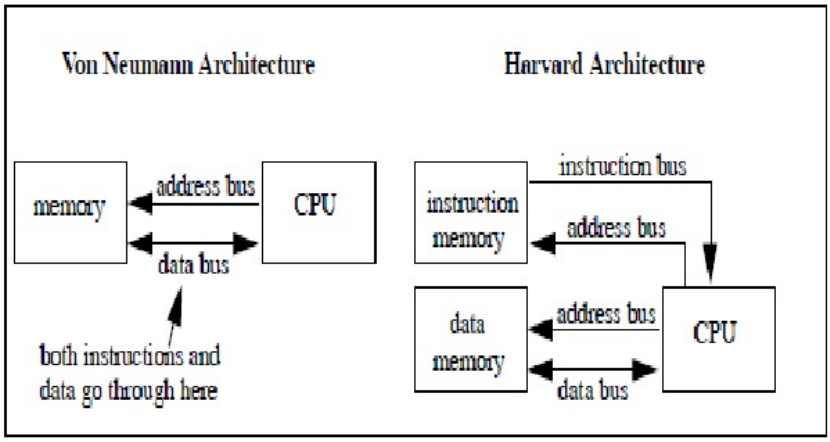
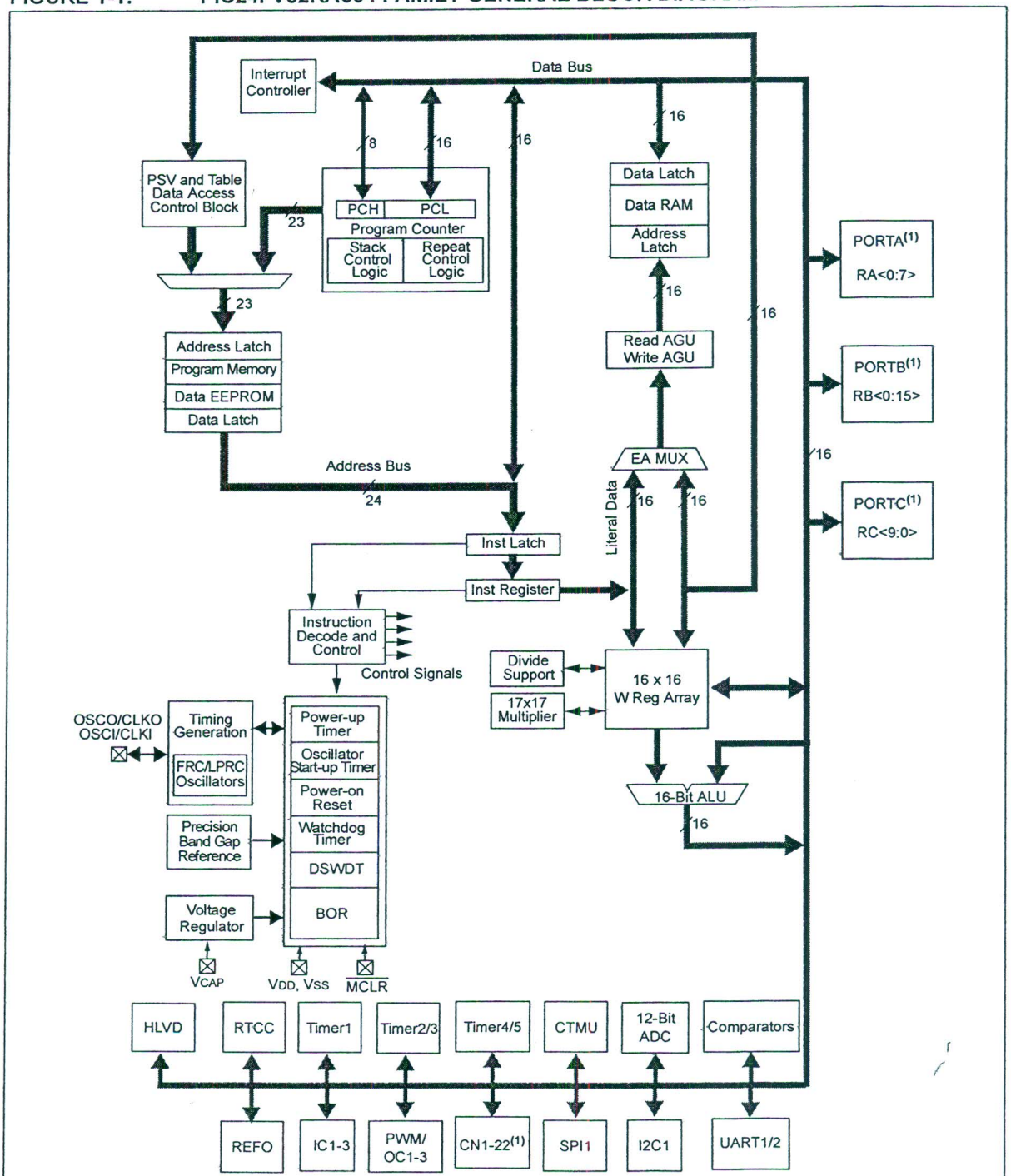


Figure 1: Harvard and VonNeumann architecture

FIGURE 1-1: PIC24FV32KA304 FAMILY GENERAL BLOCK DIAGRAM



Note 1: All pins or features are not implemented on all device pinout configurations. See Table 1-3 for I/O port pin descriptions.

The PIC microcontrollers have a great deal of support from Microchip and third-party vendors. This includes software development systems, real-time operating systems, simulators and emulators.

Development	*Support*
High Tech C	C for PIC chips
Features	Assembly and interrupt handling
RTOS	Real-time OS SALVO and others
Development	In Circuit Debuggers MPLAB , Real ICE
Documentation	Many books, Manuals, and application notes
Hardware	Evaluation boards
The Company	Reliable. Tech Help.
General	Extensive third party support
	Microchip Technology User Forums
Financial	Fairly inexpensive chips and development systems.

The choice of development tools depends on the size and scope of the project. Today, almost of the software development is done on PCs so the compilers and assemblers are *cross-software* unless they are targeting the Intel processors. (See Harman p13).

Example development systems MPLAB IDE and ICD.

For many PIC products, the microprocessor in the target product is replaced by the In Circuit Emulator header. The cost is about $1000.00.

An alternative is to use the on-board debugging code of the microcontroller. This requries a simple connection and a development system such as the ICD3 (In Circuit Debugger) for about $200.00.

Always look at the manufacturers WEB site for the latest information.

1. For the Microcontrollers (MCU) we compare the CPUs using the features shown in Table 1 also.
2. The number and type of modules is compared.
3. The amount of program and data memory is compared.
4. System protection is considered (Watchdog timers, brown-out protection, etc.)
5. Power consumption and sleep modes are often important.
6. The number of pins in a chip of one family may determine if upgrading to a more powerful MCU chip in the family is possible.

"3 views of a Microcontroller" from Harman's books.

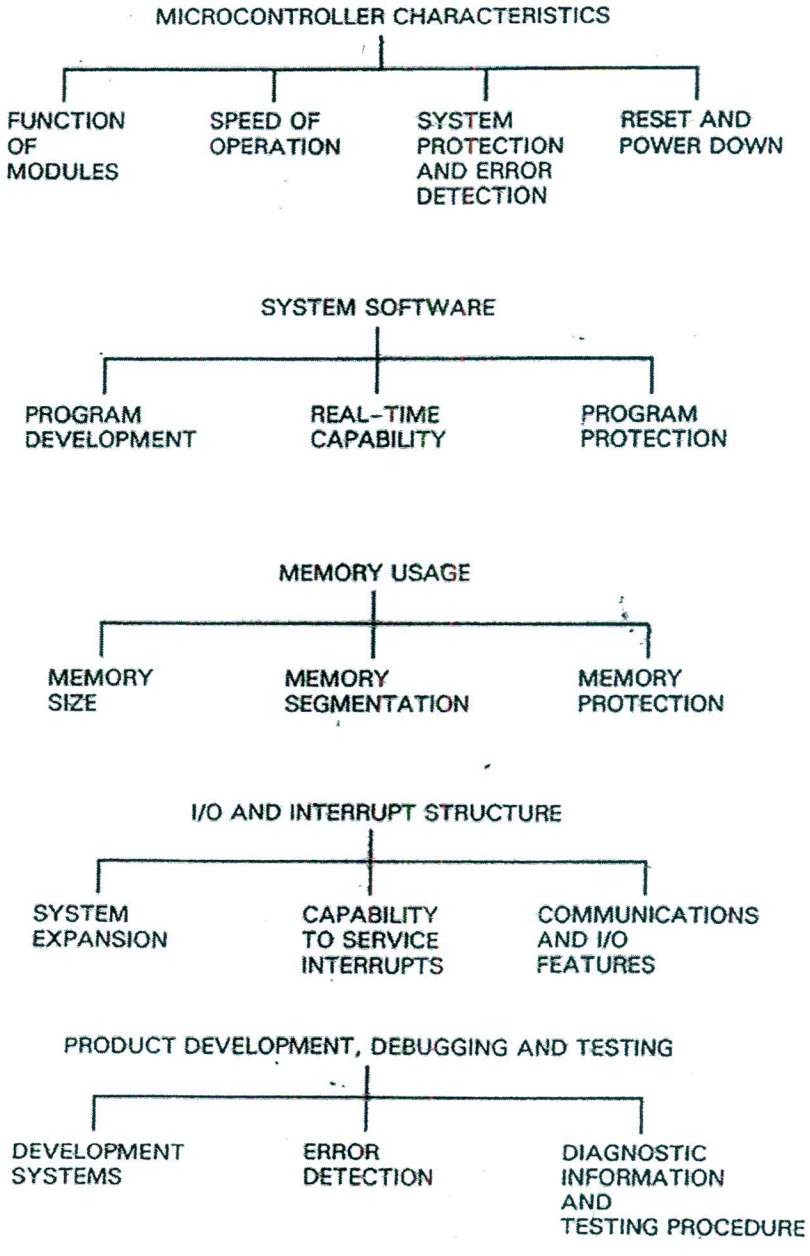


Figure 2.16 Product designer's point of view.

Other Factors may include: Temperature range, power dissipation, and cost.

The system designer is responsable for the choice of the MCU and other components to meet the requirements of the product or system.

1. At the system level, the designer is interested in the general characteristics of the MCU and how it will meet the requirements of the product design.

2. The number and type of modules is compared to the requirements for I/O, timing, etc for the product. The speed of operation of the modules must be considered if there are timing constraints.

3. The amount of program and data memory is estimated for the product as well as the types of memory required.

4. System protection is considered (Watchdog timers, brown-out protection, etc.)

5. Power consumption and heating problems are often important. Theses are determined by the ac and dc characteristics of the chip such as speed of operation and switching of the signal lines.

6. Cost and other factors are considered.

Viewing the MCU from an assembly-language programmer's point of view allows a software designer to fully understand the programmable aspects of the chip.

1. The software designer is concerned with program languages and software development systems.
2. Generally, C language is the language of choice for embedded systems today.
3. The architecture, data types, and register usage of the MCU are important.
4. Memory usage, traps, and development aids provided by the MCU are also considered.

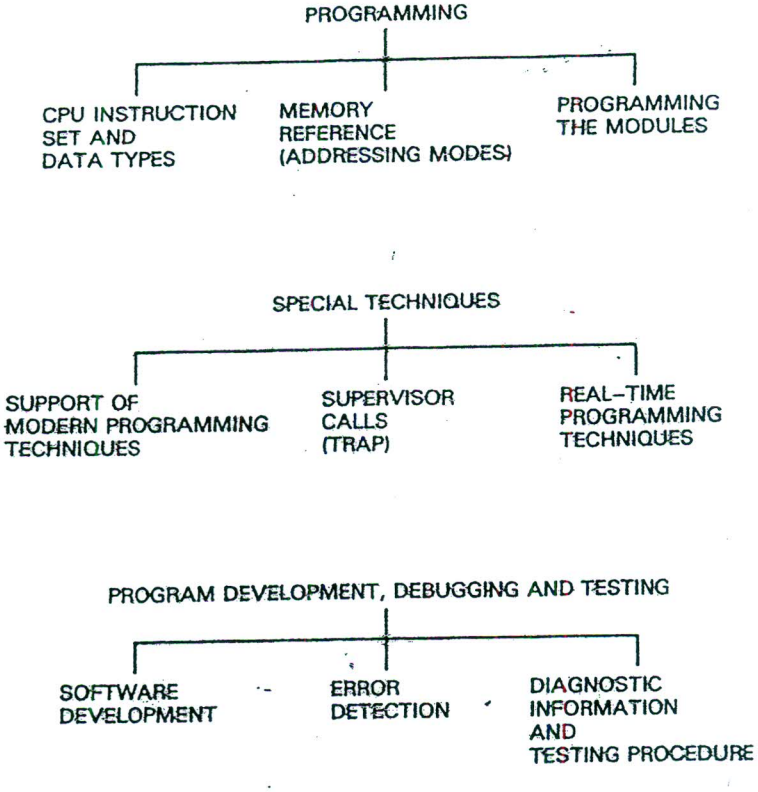


Figure 2.17 Assembly language programmer's point of view.

Viewing the MCU from a hardware or interface designer's point of view starts with an understanding of the function of the signal lines. Their function and electrical characteristics must be integrated with other chips or modules that are part of the product.

1. The function of the signal line defines "what they do" in terms of external circuits or modules.
2. The electrical characteristics include the timing of the signals as well as their drive or sinking capability.
3. Other characteristics include the ac and dc characteristics of the signal lines.

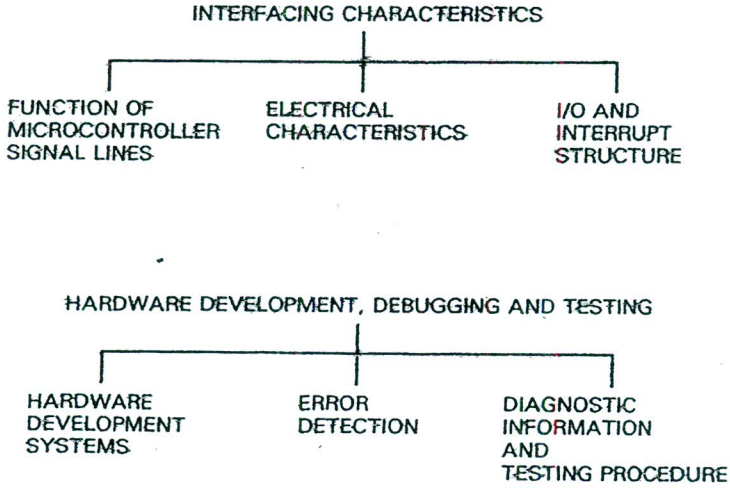


Figure 2.18 Interface designer's point of view.

The details of the electrical characteristics are found in the Data Sheet for the microcontroller.