Semiconductor Optoelectronics, *Vol. 41 No. 12 (2022), 1696-1699*
https://bdtgd.cn/

Semiconductor Optoelectronics
ISSN: 1001-5868

SELECTION OF MICROPROCESSOR FOR AN INTELLIGENT INSTRUMENT

Madhujya Gogoi
Assistant Professor, Department of Physics, Dhemaji College Dhemaji, Assam

Abstract: An instrument is smart, intelligent, versatile and above all powerful by the integration of a microprocessor. Microprocessor is the important part in the instrumentation system. Its function in the system is that of a controller. Its functions are done by hard-wired logic and mini-computer also. Suitability of them with respect to microprocessor is examined. Be wilding variety of microprocessor and micro-computers along with various I/0 requirements, put the selection of microprocessor a non-trivial task. Selections on the basis of technical, non-technical and economic considerations are reviewed.

INTRODUCTION:

A good measurement is essential for scientific research, development and industrial production. Range, accuracy, speed, reliability of measurement requirements has brought change in measurement, technology from mechanical, discrete microprocessor-based types through electro mechanical and analog electronics devices. Good measurement requires a good quality of supply (with controlled voltage, frequency etc.) and a controlled environment and these demand feedback control in instruments [1] which leads to automation in measurement, with the use of a controller analog or discrete. A microprocessor is used to make the instrument versatile, enhance metrological performance, programmable and more important; still intelligent, [2, 3, 4] making it superior to the dumb instruments. For various advantages and needs (3, 5), digital controllers in various forms of hard-wired logic, minicomputer and microprocessor are developed. Sometimes these controllers are built inside the instrument. Gradual improvement of its figure of merits in performance with respect, to watt, volume, weight, cost, etc. make it obligors and today microprocessor-based instrument, has become an advertizing buzz word. Designers have found that measurement, circuits which calls for use of more than 30 (M S I) ICs, warrants microprocessor-based instruments. Microprocessor has taken over the role of minis in instrument, technology in areas with reasonable performance limitations. Minicomputers used in measuring automation are purchased in most cases with completely developed software and hardware. In contrast, final development of micro computer is generally the user's task. Accordingly, microprocessor user must be more self reliant and more familiar with hardware and software structure than mini computer user.

Role of microprocessor in "Smart Instrument":

Microprocessors have been evolved in two directions:

(a) Micro-computer system where a CPU, memory, interfacing units and I/0 units are separate blocks. It is known as microprocessor system or general-purpose microprocessor.

(b) Single chip micro-computer-integrated system combining microprocessor with memory and I/O interfaces on the same chip.

Development, in various chip carrier packaging options (ceramic or plastic), microprocessor enhancement devices and surface mount, technology have reduced the size and increased the capability of these devices, which resulted in ousting some older versions. Pioneering 4-bit versions have become extinct, even though 4-bit, single chip micro computers are used in high volume applications. They are cheap and used in simple instruments [5, 6]. Table-1 shows the versions of development. Some classes of processors (bit slice processor of non-MOS L S I) are developed for faster operations specially in digital signal processing (e g. Intel 2920, TI's T M S 32010 etc.). Functions like graphics, printing, audio, video, self testing depends upon the amount of intelligence built into it.

Table -1: Single Chip Microprocessor and General-Purpose Microprocessor Types:

	4 bit	8 bit	16 bit	31 bit
Single Chip Micro computer	T M S 1000 C O Ps	8048/49/50 8051/52 6801/04/05 Z8	8096/97 68200	
	4004 4040 (both obsolete)	8085 Z80 6802 6809 6502	8086 80186 80286 Z8000	80386 68020 32032
			8088 80188 68008 32008	69000/10 32016

Choice of microprocessor in instrument design:

Instrument design involves a sequence of interactive decisions (3), depending on various requirements application, I/0, memory, software. In this interactive process, all the decisions are affected by the choice of the microprocessor. In some applications, there may be several acceptable candidates. Factors influencing the choice of a microprocessor are categorized as technical, economical and circumstantial. These factors may demand conflicting requirements from a microprocessor and make the selection a nontrivial task. A few of these selection criteria are examined.

The 4 bit, single chip processors are used with simple instruments in very high volume with limited computational power and speed as for bit oriented or decimal oriented applications, it, is convenient; Intel's 4040, TI's TMS 100, NSC family of 4 bit processors are specialized for direct; drive LCD's, vacuum fluorescent, displays and timing applications.

8 bit processors are most common, flexible to connect to wide range of memory and peripheral devices. Most 8 bit processors have 16 bit address bus (which may be accessed to larger data words through multiple memories) and 8 bit data bus. Intel 8085 has no multiply or

divides instructions, 8085 A is a high speed version and higher speed versions Z80A, Z80B are widely used. The later version supports DMA controller (Z 80 DMA) serial I/0 controller (Z 80 SIO or MK 3884), parallel I/0 interface (Z80 PIO or MK 3881) and programmable counter/timer (Z80 CTC or MK 3882). It is difficult to support, Z80 interrupt structure with non Z80 family devices. Motorola 6800 has less number of registers, 68A00 and 68B00 are faster versions, 6809 is a third generation of 6800, an integer multiply instruction is included and 6800 family peripherals are compatible to 6809. Different, series are provided with different facilities (ROM and RAM capacity, external or internal), clock rates and matching coprocessors.

16 bit processors have more sophisticated architecture and instruction sets. Intel's 8086, 8088, 80188, 80286, 80386, Motorola 68000, Zilog's Z 8000, Texas Instruments 9900 are all third-generation chips. These include multiply and divide instructions.

Though two 4 bit, processor can do the job of an 8 bit one, the 8 bit one is more cost effective, more facility can be built into it, improved noise immunity and performance.

Many of the functions can be implemented through either by the hardware's or by the software's. In hardware incentive approach more hardware cost, higher production cost, higher performance, low software development costs and fastness result. On the other hand, the software incentive approach less hardware, more software development cost, slower, enhanced flexibility and reduced production cost. In low volume applications, software development cost dominates and hardware implementation is often preferred; while high volume applications justify higher development cost i.e. software's.

Application characteristics:

On the application requirement, a checklist [7] regarding size and complexity of programme speed, language to be used, Arithmetic function requirements, memory, I/0, DMA requirements, Interrupt; sources and response time requirements, production volume and price sensitivity etc. needs thorough examinations. Memory requirement, of H.L. language is much higher than assembly language programmes. It has been noted that, the exact multiple ratios of these two is highly dependent on the application, the language and the programmes, but the ratio of 2:1 to 5:1 is most common. H.L. language allows quick development, of software.

Program memory and data memory requirement are to be ascertained. In disk-based systems, program is stored in disk and loaded its RAM for execution. In dedicated applications without disk storage, program is stored in RAM or EPROM. For many applications 100 to 200 bytes of RAM are required. In video game and automatic measurement programme, the cartridges contain 2 to 4 Kbytes of ROM of assembly language code. A complex test instrument like logic analyzer needs about 16 to 64 Kbytes of assembly language code. Alpha numeric displays programmes need 10 to 100 Kbytes in H.L. language. While designing single chip processors, on chip ROM and RAM requirement, must fit programme and data respectively.

Microprocessor is to communicate with outside world. Most microprocessors can be interfaced to a variety of peripheral devices including those of its family, those in other families and processor independent; devices, except DMA controller. Different: microprocessor and different forms of compatibilities [2, 8] are to be satisfied between them. All microprocessors are not equal in their interfacing ability. Hence, interfaces required should be defined before selection of microprocessor. This task of interfacing I/0 devices to a microprocessor and its management, for error free services, takes a major share of designer's effort. In early automatic measurements parallel BCD data outputs and remote-control functions and digital inputs were used [5]. In traditional automatic measurement systems, using non-standard interfaces, there is data traffic only between controller and devices. The control unit and the interfaces are strictly interrelated and cannot be altered at all.

Memory requirements, execution speed, case of software development, machine independency and arithmetic operation requirements are important factor for selection of programming language and computer also. Assembly language programming is good for memory and execution speed point of view. FORTRAN, BASIC, PASCAL are signal processing [5] HPL (a hybrid of BASIC, FORTRAN, ALGOL and PL/1) used to minimize the time and memory requirements necessary for programming complex expressions.

Conclusion:

The selection of right type of microprocessor/micro computer for a particular application is a challenging task. The selection must, begin by narrowing the field. First, the needs of application to be analyzed, second, peripherals and interfacing, third, the class of device (microprocessor or micro computer); and fourth, the word size selection. Other considerations, such as experience of staff, reputation of vendors are also important. Study on trade off between hardware software, speed and memory requirements are necessary with the help of benchmarking. Additional feature of self testing and debugging are added advantage. But it can be concluded that, a wise choice is seldom based on technical qualities of products, available software, familiarity of personnel etc. Unless cost is very critical, it is always better to have too much capability than too little.

References:

1. Barry E. Jones, ‘Instrumentation, Measurement, and Feedback’, TMH, New Delhi, 1988.
2. G. Mirsky, ‘Microprocessor and Instrumentation’, MIR, Moscow, 1987.
3. John Peatman, ‘Microprocessor based design’, Mc Gram Hik, Tojyo, 1977.
4. K.J. Bibbers, “Microprocessor and Instrumentation and control” John Wiley, 1977.
5. R. Radmi & E.G. Dinghan, “Instrument Technology”, Automatic Instruments and measuring system, Vol.5, Baterworth (London), 1989.
6. Daniels S. Query & Garey Tescher, “Advantage of microprocessor VS Discrite Digital Electronics in Appliance control” Vol.26, No.6, 1990.
7. Michase Slater, Microprocessor based design “A comprehensive guide to effective hardware design”, Prantice Hall, N.J., 1989.
8. Alan J. Weissbarger, “MOS/LSI microprocessor selection’, Electronic design, Vol.22, No.12 (June) 1974.