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Microprocessors and their applications

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Abstract.

Due to the phenomenal developments which have taken place in semiconductor technology, microprocessors have come of age and find increasing applications in almost all electronics systems. This article reviews some of these applications and with particular emphasis on their use in underdeveloped countries, especially in education.

1. Brief history.

After the invention of integrated circuits in mid 60's, there has been a constant endeavour to increase the complexity as well as the component density of these integrated circuits. Starting from a few active components like transistors, the present day integrated circuits, called LSI and VLSI (Large Scale Integrated circuits and Very Large Scale Integrated circuits) contain as many as million transistors, if not more (4M bye DRM) in a single chip of silicon. All these have been possible due to the intense research and development efforts which have taken place in Japan, USA and Europe. Microprocessors, fall in the category of LSI and VLSI and they are random logic networks whereas memories are regular array of these transistors. The present day microprocessors are nearly computers on a chip.

2. The present state of the Art.

The present state of Art in microprocessors is the 16 bit and 32 bit microprocessors, made available by Intel (80286, 80386), Motorora of USA (68000) and NEC of Japan. They are, without going into the details of technology, made by N-Mos and C-Mos technologies. Based on these technologies, there are a host of new products like Dynamic RAM'S, static RAM's (semiconductor memories), Digital signal processors (by T.I. & Motorora) and interface circuits. These devices enable one to embed the microprocessor in a dedicated system or use the microprocessor as the essential component in a versatile system like a microcomputer.

In the early days, when microprocessors came into vogue, (4 bits, 8 bits) they were incorporated into dedicated systems like scientific calculators, industrial controls, gadgets and toys and as intelligent terminals connected to a host computer. They are still being used in embedded situations like communication controllers, direct image processing applications and other gadgets.

3. Personal computer and Mircroprocessor (PC).

With the introduction of 8 bits, 16 bits and 32 bit microprocessors, the computer industry has changed from large main frames to midi, mini computers and finally to the microcomputer as evidenced by the large scale use of PC's (Personal Computer PC/AT/XT are trade marks of IBM and IBM was the first to introduce PC with Intel microprocessor 8086). The introduction of PC's into the computer market by IBM has made it possible to almost everyone to acquire a computer. This is due to the reduction in cost and today, the PC's are available, depending on the system configuration from US $ 250 to US $ 2000/-. There are very many clones of the IBM PC's with a number of interfaces. This list is too long to be enumerated here. The central tl theme idea in PC's, is that all of them have a microprocssor as the heart of the system.

The hardware configuration of a PC is built around a 8 bit, 16 bit or 32 bit microprocessor. The microprocessor is a single chip with its own ALU (Arithmetic logic unit), resident memory, cache memory, EPROM (Electronically programmable memory), I/O ports, (Input Output ports). The input to this unit is through a keyboard and output is through a printer or chrome or colour TV monitor. Depending on the end use additional memory is provided by floppy disc (1 M bye) and hard disc (4 M by memory).

The software is through DOS and PC for multi tasking and supports all low level languages. There are a number of user oriented programmes like word processor, spread sheets, graphics package and number crunching. The recent 32 bits processors support UNIX (trade mark), or Nu Bus (Harvard University, T.I. trade mark) or MCA (micro-channel architecture by IBM). There is a considerable debate in the literature as to which of these is most suitable.

Readers are referred to "further reading" at the end of this article for software. The main point in all these discussions seems to obtain the best possible solution in individual environment, taking into account cost and time.

4. Applications

The applications of microprocessors are many and they encompass a whole spectrum of tasks. At the low end of the spectrum, we have the trival task of video games, household gadgets and automobiles. Increasing in complexity, we have, Data acquisition systems, Industrial control systems, multiwork stations connected by LAN (Local Area Network), Communication Controllers, Sophisticated image processing systems, Navigation and guidance control systems and above all stand alone microcomputer, the PC. Each one of these systems has its own peculiarity in terms of software and hardware. For example, a Data acquisition system connected to x-ray diffractometer in advanced research environment is quite different from a communication controller used in industrial processing system where the computer is programmed to actuate valves and also read the process parameters. In all these situations, the microcomputer talks to and receives signals from another embedded microprocessor located on site. Each application therefore is a project by itself and these varied applications show the versatilityof usage of microprocessors. Since this article is not intended to show as to how to use the microprocessor, rather than their general usage, the details of hardware and software implementation of microprocessors are left out.

5. Microprocessors and underdeveloped countries.

industrial undertakings located in Japan and U.S.A. who can conceivably input a large amount of money to produce economically the 32 bit microprocessors and memories in large quantities. The reason is that semiconductor technology and semiconductor process equipments are too expensive and that only a few companies can well afford the same. Further, the technology itself is available only with a few companies who have so far invested billions of dollars

in research and development. It is therefore very unlikely that underdeveloped countries with their already strained resources can undertake such tasks as manufacture of microprocessors or memories. However, the underdeveloped countries can reap substantial benefits by applying the microcomputer and microprocessor technology to fulfil some of their national aspirations. For this, they need (a) sufficient resources to acquire microcomputers. (b) trained manpower and (c) a willingness to adopt the latest technology trends without inhibition. It is a confirmed view of many scholars and experts in the field that microcomputers or processors can be well suited to advance literacy in these countries.

6. Microcomputers and education.

The computer scientists, educationists have long addressed this problem of computers in education. Though the cost effectiveness of microcomputers and microprocessors have pervaded almost all parts of human activity computer in education have remained a difficult problem. The reason is that the microcomputers can be used in two ways (1) as a method of instruction from stored programmes or 2) a problem solving machine. Since the society in general consists of various strata of persons of different levels of mental abilities (including mentally handicapped) a universal common denominator in either software or hardware cannot be adopted. For example teaching to 5-10 years old with computers can be completely different from teaching 10-15 years old. Further teaching arithmetic which needs only drawn lines to teaching biology can be different. The so called CAI, (Computer Aided Instruction) has not come out with necessary courseware or the necessary hardware for teaching to all sections of the population. Further, since natural language is most easily taught, there are few computer programs which recognise natural languages. Inspite of all these difficulties, the cost effectiveness of microcomputers has made it possible to distribute these computers most widely in private and public schools both in US and Europe and in some developing countries like India. The computer education in these instances is that the computer aids the instruction from stored programs and also familiarise the students with computer operation without any fear or inhibition. The problem solving by the PC is still not widely used.

It is therefore most appropriate that underdeveloped countries, can take advantage of the low cost of micro computers and microprocessors based educational kits. These microcomputers are used as aid to the instructions in schools. Further, a meaningful curriculum courseware ~~is~~ is drawn up to use these microcomputers effectively. This requires extensive teacher training, a set of programs stored in main computers, and a set of system analysts and programmers who can update the system from feedback from schools.

Conculsion.

The stupendous technological advancements in semiconductor electronics has given us microcomputers, microprocessors and "Computers in a brief case". These achivements stemmed from a simple idea of transistor invented some years ago, have put us in the information age. It is but appropriate that the benefits of such information processing, distribution, should be made use of by the developing countries to achieve their national goals and aspirations, of which literacy is most important.

Further reading.

1) K. Haefner "The challenge of Information technology to Education" EDUCATION AND COMPUTING Vol. No.3. Sept. 85.

2) Technology update in COMPUTER DESIGN Feb.1, 89.

3) Technology update in EDN Nov. '89.