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MICROPROCESSOR APPLICATIONS

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THE MICROPROCESSOR--ANOTHER MEMBER OF THE MINI(MAL) COMPUTER FAMILY

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Minicomputer ancestry began with EDSAC at the first operating stored program computer at the University of Cambridge, in 1949. EDSAC, a 17-bit computer, was in contrast to the large multiple address, wide word computers built in the early 50's to do scientific calculations. Aerospace and process control computers of the early 60's also claim to be antecedents. Minicomputers (for minimal computers) are a state of mind: the current logic technology and the many characteristics available from large computers are combined into a package to provide the lowest possible cost (for that technology). The microcomputer is generally accepted to be a small, low cost computer with minimal capability, built on a small number of integrated circuits. Thus, there is no surprise that the microprocessor is a member of the mini(mal) computer family.

If we look at the leading edge price of the minimal computers (since the first, 1961, $60,000 minicomputer) and assume a 40% decrease in cost per year, then in 1974, the cost of the minicomputer should be about a factor of 36 lower, or have a price of about $1,600. Two researchers at IBM postulate a 5000 circuit processor with 20,000 8-bit bytes of memory in the late 1970's to cost about $75.

The technological force that has caused the current, common cost for a computer, almost independent of whether it has very low performance as in the case of the large scale integrated circuit processor-on-a-chip type processors, or the higher performance matched to the 1 microsecond memories, is the semiconductor industry. This industry has produced components at a cost/performance improvement rate of over 60% per year for almost a decade. With technological cost-performance advancement, three possible trends can be observed:

1. Provide the minimal cost system, independent of technology. In essence, this usually provides a constant or declining performance, and a decrease in cost at the technological rate (40%).
2. Hold the cost constant to provide either more performance with better technology, or with increased number of components. (In essence, the standard computer provides for more performance at relatively the same price.)
3. Build structures that were impossible to build with the previous technology.

Technology improvements in semiconductors are a combination of cases 1 and 3. The processor-on-a-chip is both the minimal machine, and also a change in structure which was previously not provided. Subsequent new applications are possible each time the price is lowered.

Now many integrated circuit manufacturers have an MOS "microprocessor-on-a-chip" (eg., Intel, National, Rockwell, Fairchild), all of which sell for about $30; and when properly outfitted with memory, and associated driving and interface circuitry, provide a system which costs about the same as a conventional minicomputer. Certainly, if packaged and powered, the price difference is negligible, but the performance of the former is minimal. Alternatively, by combining standard integrated circuits to form processors, substantially faster processors can be built.

The main determinate of price is not the basic computer mounted on a board and ready to use in some sort of system, but the assembly and testing of integrated circuits on a board together with any mounting hardware.

The several choices for a "system" designer are:

1. Standard IC's in a microcontroller structure.
2. Additional IC's (the arithmetic unit) to form a processor (and computer).
3. Microprocessor IC and memory to form a computer.
4. Microprocessor IC mounted on a board to form a computer.
5. Standard IC's to form a conventional minicomputer--mounted on a board.
6. A minimal computer mounted in a frame, with power supply, and additional interface capability.

No matter which alternative is used, systems design is being carried out by using stored program computers. Sequential and combinational logic design are being transformed into the design of programs.