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Microprocessors: brain of computers

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ABSTRACT

A microprocessor is a multipurpose, programmable device that accepts digital data as input, processes it according to instructions stored in its memory, and provides results as output. It is an example of sequential digital logic, as it has internal memory. Microprocessors are sequentially accessed (means they have a memory storage device in it).they operate on numbers represented in binary numeral system. These are generally used for the purpose of computation, editing, multimedia, display and communication over the internet. Many more microprocessors are part of embedded systems, providing digital control of a myriad of objects from appliances to automobile to cellular phones and industrial process control.

Keywords: Sequential:-devices which have a memory element in them, Multimedia:- It is a media and content that uses a combination of different content forms, Integrated circuits:- These are the hardware devices which are small chips on which there is present a large number of logic gates, Binary numeral system:- It represents numeric values using two symbols;0 and 1.

1. INTRODUCTION

Microprocessors are the sequential devices which usually perform the whole procedure done in a computer.

1.1. History

It was invented in 1960s.they are usually constructed out of small and medium-scale ICs each containing from tens to a few hundred transistors. For each computer built, all of these had to be placed and soldered onto printed circuit boards, and often multiple boards would have to be interconnected in a chassis. The large number of discrete logic gates used more electrical power-and therefore, produced more heat-than a more integrated design with fewer ICs. The distance that signals had to travel between ICs on the boards limited the speed at which a computer could operate. The first microprocessors were emerged in the early 1970s and were used for electronic calculators, using binary-coded decimal (BCD) arithmetic on 4-bit words. Other embedded uses of 4-bit and 8-bit microprocessors, such as terminals, printer, various kinds of automation etc. followed soon after. Affordable 8-bit addressing also led to the first general-purpose microcomputers from the mid -1970s on (Torresola et al. 2005).

1.2. Embedded Applications

Thousands of items that were traditionally not computer –related include microprocessors. These include large and small household appliances, cars (and their accessory equipment units), car keys, tools and test instruments, toys, light battery packs, and hi-fi audio/visual components (from DVD players to phonograph turntables). Such products as cellular telephones, DVD video system an ATSC HDTV broadcast system fundamentally require consumer devices with powerful, low cost, microprocessors (Moore et al. 1965). Increasingly stringent pollution control standards effectively require automobile manufacturer's engine management systems, to allow optimal control of emissions over widely varying operating conditions of an automobile. Non-programmable controls would require complex, bulky or costly implementation to achieve the results possible with a microprocessor. A microprocessor program can be tailored to different needs of a product line, allowing upgrades in performance with minimal redesign of the product. Different features can be implemented in different models of a product line at negligible production cost.

1.3. Structure

The internal arrangement of a microprocessor varies depending upon the age of the design and intended purpose of the processors. The complexity of an integrated circuit is bounded by physical limitations of the number of transistors that can be put onto one chip, the number of package terminations that connect the processors to other parts of the system, the number of interconnections it is possible to make on the chip, and the heat that the chip can dissipate. Advancing technology makes more complex and powerful chips feasible to manufacture. It also consists of ALU and a control logic section. The ALU perform the task of calculating all the arithmetic operations. The logic section retrieves instruction operations of the ALU required to carry out instruction. Occasionally the physical limitations of integrated circuits made such as a bit slice approach

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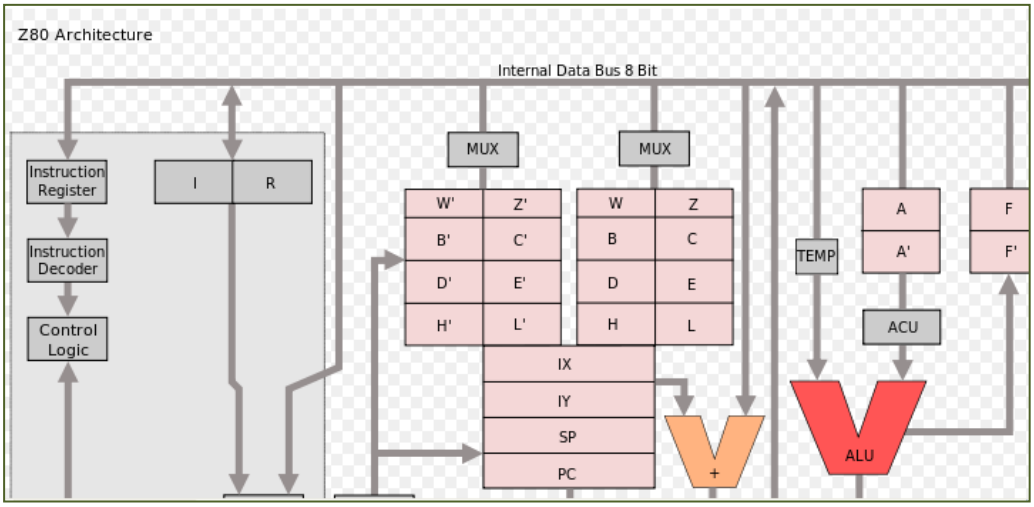

necessary. Instead of processing all of processing all of a long word on one single integrated circuits made such practices as a bit slice approach necessary. Instead of processing all of a long word on one integrated circuit, multiple circuits in parallel processed subsets of each data word (Torresola et al. 2005). While this required extra logic to handle, for example, carry and overflow within each slice, the result was a system that could handle, say, 32-bit words using integrated circuits with a capacity for only 4 bits each.

1.4. Intel 4004

The Intel 4004 is generally regarded as first commercially available microprocessor, and cost $60 the first known advertisement for the 4004 is dated November 15, 1971 and appeared in Electronic news. It consists of a large numbers of chips. Three of the chips were to make a special-purpose CPU with its program stored in ROM and its data stored in shift register read-write memory. Later on Hoff (a reputed scientist) came with four-chip architectural proposal: a ROM chip for storing data, a simple I/O device and a 4-bit central processing unit (CPU).

1.5. MCS-4

This is the microprocessor developed under Intel processor technology. This was the single-chip CPU. The manager of Intel's MOS Design Department was Leslie. Vadász. at the time of the MCS-4 development, but Vadasz's attention was completely focused on the mainstream business of semiconductor memories and he left the leadership and the management of the MCS-4 project to Faggin, which was ultimately responsible for leading the 4004 project to its outcome.

1.6. TMS 1000

TI developed the 4-bit TMS 1000 and stressed pre-programmed embedded applications, introducing a version called the TMS1802NC on September 17, 1971 which implemented a calculator on a chip. TI filed for the patent on the microprocessor. A computer-on-a-chip combines the microprocessor core (CPU), memory, and I/O (input/output) lines onto one chip.

1.7. Pico/General Instrument

General Instrument (GI) introduced their first collaboration in ICs, a complete single chip calculator IC for the Monroe/Litton Royal Digital III calculator. This chip could also arguably lay claim to be one of the first microprocessors or microcontrollers having ROM, RAM and a RISC instruction set on-chip (Moore et al. 1965). The layout for the four layers of the PMOS process was hand drawn at x500 scale on mylar film, a significant task at the time given the complexity of the chip.

1.8. CADC

The design was significantly (approximately 20 times) smaller and much more reliable than the mechanical systems it competed against, and was used in all of the early Tomcat models. This system contained "a 20-bit, pipelined, parallel multi-microprocessor".

2. VARIOUS TYPES OF MICROPROCESSOR

2.1. 8-bit designs

The 8008 was the precursor to the very successful Intel 8080 (1974), which offered much improved performance over the 8008 and required fewer support chips, Zilog Z80 (1976), and derivative Intel 8-bit processors. The competing Motorola 6800 was released August 1974 and the similar MOS Technology 6502 in 1975 (both designed largely by the same people). The 6502 family rivaled the Z80 in popularity during the 1980s (Venkatasubramanian et al. 2001). A low overall cost, small packaging, simple computer bus requirements, and sometimes the integration of extra circuitry (e.g. the Z80's built-in memory refresh circuitry) allowed the home computer "revolution" to accelerate sharply in the early 1980s. This delivered such inexpensive machines as the Sinclair ZX-81, which sold for US$99. A variation of the 6502, the MOS Technology 6510 was used in the Commodore 64 (The Commodore 64, commonly called C64, C=64 occasionally CBM 64 for Commodore Business Machines), or VIC-64, was an 8-bit home computer introduced in January 1982 by Commodore International and yet another variant, the 8502, powered the Commodore 128.

2.2. 12-bit designs

The Intersil 6100 family consisted of a 12-bit microprocessor (the 6100) and a range of peripheral support and memory ICs. The microprocessor recognized the DEC PDP-8 minicomputer instruction set. As such it was sometimes referred to as the CMOS-PDP8. Since it was also produced by Harris Corporation, it was also known as the Harris HM-6100. By virtue of its CMOS technology and associated benefits, the 6100 was being incorporated into some military designs until the early 1980s.

2.3. 16-bit designs

The first multi-chip 16-bit microprocessor was the National Semiconductor IMP-16, introduced in early 1973. An 8-bit version of the chipset was introduced in 1974 as the IMP-8. The Intel x86 processors up to and including the 80386 do not include floating-point units (FPUs). Intel introduced the 8087, 80287, and 80387 math coprocessors to add hardware floating-point and transcendental function capabilities to the 8086 through 80386 CPUs. The 8087 works with the 8086/8088 and 80186/80188, the 80187 works with the 80186/80188, the 80287 works with the 80286 and 80386, and the 80387 works with the 80386 (yielding better performance than the 80287). The combination of an x86 CPU and an x87 coprocessor forms a single multi-chip microprocessor; the two chips are programmed as a unit using a single integrated instruction set. Though the 8087 coprocessor is interfaced to the CPU through I/O ports in the CPU's address space, this is transparent to the program, which does not need to know about or access these I/O ports directly; the program accesses the coprocessor and its registers

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through normal instruction opcodes. Starting with the successor to the 80386, the 80486, the FPU was integrated with the control unit, MMU, and integer ALU in a pipelined design on a single chip (in the 80486DX version), or the FPU was eliminated entirely (in the 80486SX version). An ostensible coprocessor for the 80486SX, the 80487, was actually a complete 80486DX which disabled and replaced the coprocessor less 80486SX that it was installed to upgrade (Venkatasubramanian et al. 2001).

2.4. 32-bit designs

The most significant of the 32-bit designs is the MC68000, introduced in 1979. The 68K, as it was widely known, had 32-bit registers in its programming model but used 16-bit internal data paths, 3 16-bit Arithmetic Logic Units, and a 16-bit external data bus (to reduce pin count), and externally supported only 24-bit addresses (internally it worked with full 32 bit addresses). In PC-based IBM-compatible mainframes the MC68000 internal microcode was modified to emulate the 32-bit System/370 IBM mainframe (Atluri et al. 2003). Motorola generally described it as a 16-bit processor, though it clearly has 32-bit capable architecture. The combination of high performance, large (16 megabytes or 2^{24} bytes) memory space and fairly low cost made it the most popular CPU design of its class. The Apple Lisa and Macintosh designs made use of the 68000, as did a host of other designs in the mid-1980s, including the Atari ST and Commodore Amiga (Peeples et al. 2001). The world's first single-chip fully 32-bit microprocessor, with 32-bit data paths, 32-bit buses, and 32-bit addresses.

2.5. 64-bit designs in personal computers

The move to 64 bits by PowerPC processors had been intended since the processors' design in the early 90s and was not a major cause of incompatibility. Existing integer registers are extended as are all related data pathways, but, as was the case with IA-32, both floating point and vector units had been operating at or above 64 bits for several years (Peeples et al. 2001). Unlike what happened when IA-32 was extended to x86-64, no new general purpose registers were added in 64-bit PowerPC, so any performance gained when using the 64-bit mode for applications making no use of the larger address space is minimal.

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