A Study of Microprocessors Uses and Its Software Applications

Mr. Parveen
Department of Computer Science

Abstract: *The term 'microprocessor' came into existence in 1971, when the Intel Corporation of America, developed the first microprocessor (Intel-4004) which is a 4-bit microprocessor. A microprocessor is one of the most important components of digital computer. The microprocessor is a programmable integrated device that has computing and decision making capability similar to that of central processing unit (CPU) on a single semi-conducting integrating circuit. A digital computer in which microprocessor has been provided to act as CPU, is called microprocessor.*

Keywords: Microprocessor, CPU, Program, Application, Digital Signature.

Introduction: A microprocessor is specified by its "word-length" e.g. 4-bit, 8-bit, 16-bit etc. By the term word-length means the number of bits that is processed by the microprocessor as unit. For example, an 8-bit microprocessor can process 8-bit data at a time. It also specifies the width of data bus. A digital computer has four components: memory, input, output and central processing unit (CPU), which consists of Arithmetic/Logic Unit (ALU) and control unit. The CPU is the primary and central player in communicating with devices such as memory, input and output. However the timing of communication processes is controlled by the group of circuits called control unit. The CPU is commonly referred to as microprocessor. Microprocessor made possible the advent of microcomputer in mid-1970s. Before this period, CPU was typically made from bulky discrete switching devices. Later on small scale integrated circuits were used to design the CPUs. By integrating processor onto one or a very few large scale integrating circuit package (containing the equivalent of thousands or millions of discrete transistors), the cost of processor was greatly reduced.

The evaluation of microprocessors has been known to follow Moore's law when it comes to steadily increasing performance over the years. This law suggests that complexity of an integrated circuit, with respect to minimum component cost, doubles in every 18 months. This dictum has generally proven true since the early 1970s. from there humble beginnings as the drivers for calculators, the continued increase in power has led to the dominance of microprocessors over every other form of computers now uses a microprocessor as its core.

The microprocessor plays a significant role in everyday functioning of industrialized societies. The microprocessor can be viewed as a programmable logic device that can be used to control processes or to turn on/off devices. On the other hand, the microprocessor can be viewed as a data processing unit or a computing unit of a computer. Now a day, the microprocessor is being used in wide range of products or systems. This chapter introduces the basic structure of a few microprocessors and their comparative study. The microprocessor communicates in binary digits 0 and 1 called bits. Each microprocessor has a fixed set of instructions in the form of binary patterns called a machine language of 0s and 1s. Therefore, the binary instructions are given abbreviated names called, mnemonics, which forms the assembly language for a given microprocessor.

Research Objectives: In the present research paper the experimental work on 8085 microprocessor has been discussed:

1. Description of Intel 8085 microprocessor with its instruction set and software applications will be discussed.
2. The most important part for the use of 8085 microprocessor is the peripheral device that can be connected to the microprocessor for various domestic work or other types of applications.
3. Various peripheral devices such as Intel 8253, Intel 8279, and Intel 8255 will be discussed.
4. Program for a new application real time clock with predefined timing alarms is given that has been checked.

Special Designs: A microprocessor is a general purpose system. Several specialized processing devices have followed from the technology. Microcontrollers integrate a microprocessor with peripheral devices in embedded systems. A digital signal processor (DSP) is specialized for signal processing. Graphics processing units may have no limited or general programming facilities. For example, GPUs through the 1990s were mostly non-programmable and have only recently gained limited facilities like programmable vertex shades. 32-bit processors have more digital logic than narrower processors, so 32-bit (and wider) processors produce more digital noise and have higher static consumption than narrower processors. Reducing digital noise improves ADC conversion results. So, 8-bit or 16-bit processors are better than 32-bit processors for system on a chip and microcontrollers that require extremely low-power electronics, or are part of a mixed-signal integrated circuit with noise-sensitive on-chip analog electronics such as high-resolution analog to digital converters, or both. Nevertheless, trade-offs apply: running 32-bit arithmetic on an 8-bit chip could end up using more power, as the chip must execute software with multiple instructions. Modern microprocessors go into low power states when possible, and an 8-bit chip running 32-bit software is active most of the time. This creates a delicate balance between software, hardware and use patterns, plus costs.

When manufactured on a similar process, 8-bit microprocessors use less power when operating and less power when sleeping than 32-bit microprocessors. However, some people say a 32-bit microprocessor may use less average power than an 8-bit microprocessor when the application requires certain operations such as floating-point math that take many more clock cycles on an 8-bit microprocessor than a 32-bit microprocessor so the 8-bit microprocessor spends more time in high-power operating mode.

Microprocessor Design Philosophy:

AMD AND INTEL AMD and Intel manufacturers have common goal which is high performance at a very low cost. There is high demand of Servers that rank high in terms of scalability and reliability. AMD and Intel adopt different approaches to accomplish this critical mission. It is on this note that we decided to compare the design concept of AMD Opteron with that of Intel Xeon. Intel and AMD have the same design philosophy but different approaches in their micro architecture and implementation. AMD technology uses more cores than Intel, but Intel uses Hyper-threading technology to augment the multi-core technology. AMD uses Hyper-Transport technology to connect one processor to another and Non-Uniform Memory Access to (NUMA) to access memory. Intel on the other hand sues Quick Path Interconnect technology to connect processor to one another and Memory controller Hub for memory access. AMD supports virtualization using Rapid Virtualization Indexing and Direct Connect architecture. While Intel virtualization technology is Virtual Machine Monitor. AMD ranked higher in virtualization support than Intel.

Moreover, the Quick Path Interconnect in Intel ProLiant server have self-healing links and clock failover, hence their technology focuses more on data security while AMD ProLiant servers focuses more on power management. The Ivy-Bridge hybrid and HGCC technology indeed proved that two good heads are better than one. But AMD is in the frontline of these two technologies. These hybrid servers outperformed other servers.

Quad-Core Technology: A quad-core processor is a chip with four independent units called cores that read and execute central processing unit (CPU) instructions such as add, move data, and branch. This comparison is based on AMD Opteron 8350 series and Intel Xeon X7350 series. According to a press release, the processor combines four Opteron cores into one chip. Each die consist of a single integrated memory controller and uses Hyper Transport technology to connect one processor with another. The clock speed of each core is 2.0 GHz, at a performance of 32 Gflop/s. The technology designed for memory access is Non –Uniform memory Access (NUMA) while the channel of communication between two processors is Quick Path Interconnect architecture. On the other hand, Xeon 7350 processor is configured with two dual-core dies packaged into a single Dual-chip Module (DCM) its clock speed is 2.93 GHz, its theoretical performance is 46.9 Gflop/s which is relatively higher than that of AMD Opteron 8350. Its micro architecture also includes Symmetric Multiprocessor (SMP).

Virtualization Support: Virtualization is a framework that makes provision for a common platform to run more than one operating system and application resources. Here we review how the different manufactures support virtualization in a distributed system with particular reference to Intel and AMD processors. According to the virtualization technologies of the two manufactures are similar in functionalities but not compactable. AMD Opteron processor enables virtualization leading efficiency by implementing Rapid Virtualization Indexing and Direct Connect Architecture. This architecture enables the server or cluster of servers in a distributed system to have high throughput responsiveness for applications and data access. The virtualization technology focuses on high band-width and low latency access to memory.

HP Proliant Servers: The philosophy of any processor design is to ensure it delivers the best services at minimized cost. AMD achieves this goal by providing more cores to run multithreaded applications through of mapping more than one thread to a core. Intel on the other hand maximized its core by using Hyper-Threading technology to execute two core threads per core.

- **Intel Xeon Processor ProLiant Servers:** The following are the some prominent features of Intel Xeon Processor in ProLiant Server: Quick Path Interconnect (QPI) - this is used to connect the processor and the I/O chipset. The QPI has• self- healing links and clock failover. This special feature (QPI) transmits data across 20-bit link; the link is subdivided into quadrant of five lanes, such that in an event of error in one quadrant, the link automatically reduces its width using only the good lane thereby recovering from multiple errors without data loss. This helps to enforce the ACID property of the database. Moreover, if the clock fails, the link reduces and the clock maps to a predetermined data lane. The only effect however that is the Reliability, while Availability and Serviceability mode is reduced without distorting the operation. Trusted Execution Technology (TXT) – this feature ensures that the server is protected against• malicious software attack. Intel Machine Check Architecture Recovery – this feature that allows the Operating System to run even• after detecting uncorrectable errors, thereby enforcing reliability. According to two processor- based

Gen8 servers uses Intel E-2600 series processor that operates between 60W to 135W. The processor is consist of L1, L2, and L3 cache, two Quick Path Interconnect links, four memory channels of about 16MT/s each as well as other types of load-reduced DIMMs that enables the processor to comfortably execute high traffic transactions in a distributed environment.

- **AMD Opteron ProLiant Servers**: AMD Opteron 6100 supports the following features:
  - Hyper Transport (HT) Assist – this feature is used to maintain the data correctness between processors and reduces inter-processors communication traffic on the HT links.
  - AMD-Power suit - this feature ensures power management at reduce cost.
  - AMD-V – this feature uses the Rapid Virtualization Indexing to reduce software virtualization overhead.

The I/O architecture of both AMD Opteron 6100 and Intel Xeon E5-2600 processor- based ProLiant servers are the same, but different approaches were used for the implementation. The AMD uses Hyper Transport 3.0 (HT3) technology to move data to the processors, memory and I/O devices. The HT3 Interconnect consists of one 16 bit (wide) or two 8-bit (narrow) links. The wide link gives an at least data rate of 6.4 giga transfer per second. The technology improves system performance since the processors can communicate directly rather than moving data from one processor to another.

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 switches/dimmers and electrical circuit breakers, smoke alarms, battery packs, and hi-fi audio/visual components (from DVD players to phonograph turntables). Such products as cellular telephones, DVD video system and HDTV broadcast systems fundamentally require consumer devices with powerful, low-cost, microprocessors. Increasingly stringent pollution control standards effectively require automobile manufacturers to use microprocessor 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 control program (embedded software) can be easily 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. Microprocessor control of a system can provide control strategies that would be impractical to implement using electromechanical controls or purpose built electronic controls. For example, an engine control system in an automobile can adjust ignition timing based on engine speed, load on the engine, ambient temperature, and any observed tendency for knocking allowing an automobile to operate on a range of fuel grades.

Conclusion: Microprocessors single chip computers are the building blocks of the information world. Their performance has grown 1,000 fold over the past 20 years, driven by transistor speed and energy scaling, as well as by micro architecture advances that exploited the transistor density gains from Moore's Law. In the next two decades, diminishing transistor-speed scaling and practical energy limits create new challenges for continued performance scaling. As a result, the frequency of operations will increase slowly, with energy the key limiter of performance,

forcing designs to use large-scale parallelism, heterogeneous cores, and accelerators to achieve performance and energy efficiency. Software-hardware partnership to achieve efficient data orchestration is increasingly critical in the drive toward energy-proportional computing. Our aim here is to reflect and project the macro trends shaping the future of microprocessors and sketch in broad strokes where processor design is going. We enumerate key research challenges and suggest promising research directions. Since dramatic changes are coming, we also seek to inspire the research community to invent new ideas and solutions address how to sustain computing exponential improvement.

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