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STRUCTURAL MATHEMATICS MODELING.(U)
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University of Maryland, College Park
Department of Aerospace Engineering

Final Report on Structural Mathematics Modeling

N00014-75-C-0902

Harry Schaeffer

Final Report on Structural Mathematics Modeling

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by Harry Schaeffer

Introduction

The purpose of this study is to evaluate the potential of microcomputers for supporting engineering analysis. The study was motivated by the introduction of low-cost microcomputers and associated peripheral equipment.

Hardware Selection

The basic criterion that was used during the hardware selection phase was to obtain the largest computing potential for the funds available. This decision was made on the basis of no experience in procuring computer hardware and turned out to be a poor one.

The first indication that hardware selection is not as easy as putting a good hi fi set together is the fact that one must deal with a salesperson who is interested formost in making a sale and who may know little about the technical aspects of his equipment or the buyers requirements.

The typical hardware purchaser may think in terms of

- o Central processor unit (cpu)
- o Core size and address space
- o Mass storage devices

However, the computer actually comes bits and pieces so that the salesperson is thinking in terms of

- o Central Processing board
- o Random access memory boards (RDM)
- o Serial Interface boards

- o Floppy disc and associated interface boards
- o Backplanes
- o Power supplies
- o Real time clock
- o Sales commission
- o etc.

At the time the computer to be used in this study was being configured there was no alternative to building the system using off-the-shelf components. Fortunately, the rapid development of the market place has led to the appearance of system integration specialists. These firms sell prepackaged computer systems that may comprise components from several manufacturers. The prepackaged systems can then be modified to accommodate any special user requirements.

After reviewing the list of computer components an order was placed for a microprocessor based on large scale integrated chip (LSI) technology. The original order included

- o Power supply and backplanes
- o Real Time clock
- o Floating point instruction set
- o LSI microprocessor based on 16 bit word
- o A serial interface board
- o A dual floppy disk with interface board
- o 12K bytes or random access memory
- o An operating system

After the order was placed two fortuitous events took place.

1. Approval of the proposed procurement by the State of Maryland took eight months.

2. The backplane and power supply were introduced in a packaged form. Thus, prior to shipment the order was changed to a PDP11/03 which is a microcomputer using the LSI-11 chip distributed by the Digital Equipment Company.

Hardware Delivery

The hardware was delivered approximately eight months after state approval (the procurement cycle was thus 16 months). The equipment came in two unlabeled boxes with practically no instructions. One box contained the PDP11/03, cables, small boxes of electronic hardware, and about two feet of manuals. The other box contained the dual floppy discs. At that time it was impossible to tell one component from another let alone how the cables etx. were to be used. The next month was thus spent reading the manuals (which accounted for the most bulk in the system).

An interesting observation that can be made was a result of this study is that one either has to have some background in digital electronics or learn about the field very quickly; and this was a learning process. The fact is that one must be a semi expert in all aspects of computer systems.

The study goes on and on. It might be entitled the "education of a microcomputer user", but in summary the following actions were required to obtain a system that was capable of supporting the evaluation of microcomputer systems.

- o System was upgraded to 56KB of RAM memory
- o FORTRAN and BASIC software systems were obtained
- o A software integration specialist packaged the entire system with expanded backplane slots.

These additional procurements required an additional 18 months. The system that we had envisioned in April of 1975 was thus a reality in December of 1978. The system has the following characteristics.

- o LSI-11 cpu that completely emulates the PDP11 instruction set
- o 56KB of refreshed memory
- o Dual 256KB floppy discs giving total mass storage of 512KB
- o RT-11 operating system
- o FORTRAN compiler
- o BASIC
- o Three band-selectable serial interface boards
- o 1200 band hard copy terminal device

The communications boards allow the unit to support two terminal devices and a high speed modern to a mainframe simultaneously. In this configuration the unit can be software-configured to emulate an RJE terminal for any of the mainframe computers. This software wasn't included, but a software package was obtained to allow the microprocessor to communicate directly with the mainframe using the RS232 interface. This later feature allows files to be transferred directed from floppy disc to mass storage on the main frame and vice versa.

Software Development on the Microprocessor

The system described above is completely responsive to the user, and may prove to be an integral part of a system for software development. In order to evaluate the concept the direct conversion of the SAPIV program to the microprocessor environment was attempted. Selected modules were modified to execute on the system but the minimum amount of code required to give some semblence of SAPIV was so large that it wouldn't fit on a single floppy disc.

After this experience with usable batch oritented software I conclude:

1. Batch-oriented programs were not appropriate. A new software system that takes advantage of the interactive operating system is required.

2. The floppy discs are much to slow to support serious computing. The system should be configured to include a 10MB hard disc at a minimum.
3. The cost of the cpu is minor compared to the software and peripherals. A useful engineering support system should thus be configured using a mini computer such as the PDP11/34, the Prime 300, or the Interdata 32 bit mini's.
4. The main role of microcomputers would seem to be as interface controllers of graphic systems or other peripherals rather than as being serious competitors to the modern mini computers.
5. Operating systems such as RT-11 on the Digital Equipment Computers and PRIMOS on the Prime Computers provide the software developer with utilities that are generally superior to those available on the main frames.