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For your information

A HARVEST DISCUSSION

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MPRO-03

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GENERAL DEFINITION OF THE HARVEST SYSTEM

By basic definition, HARVEST is a high speed computing system, designed to provide an increase in overall performance, on large scale computing problems, of the order of 90 to 100 times the processing speed of the existing 704 data processors.

This objective is being accomplished through the combined use of a number of relatively new ideas in the field of computing machine technology. These include such items as overlapped operation within the basic computing facilities, new input-output facilities, and a very powerful and flexible instruction set. Also, greatly increased reliability is expected to be obtained by employing solid state components throughout the entire system.

MEMORIES

Present plans of the HARVEST System specify the availability of two distinct types of magnetic core memory, designated as "main" memory and "fast" memory. Memory words in both types contain 64 information bits and 8 nonaddressable redundancy bits.

Each "main" memory unit will contain 16,384 words with a read-write time of approximately 2.25 microseconds. A maximum of 16 such units is possible.

A "fast" memory unit is scheduled to have a read-write cycle time of approximately .75 microseconds with 1024 memory words. A HARVEST System will be limited to a total of 4 units of this type.

The HARVEST System will have 2 each of the 2 types of memory, for a total of 34,816 memory words; however, several word addresses within the "fast" memory will be reserved for index registers, and other special registers, such as the Accumulator, the Remainder Multiplier, etc. Each memory unit, within a given type of memory ("main" or "fast") will operate independently of any other unit of that type, permitting several memory references to be in progress at the same time.

In most types of instructions the position of a single bit in any memory word may be directly addressed. Because of this facility of bit addressing, the entire memory can be considered as a series of consecutively addressed bits, without regard for memory word boundaries. It is then possible to address information in memory by fields, specifying the first bit position of the field, and the total number of bits in the field.

EXCHANGE UNITS

The purpose of the two exchange units, both Basic and High Speed, is to control the flow of information between external units and the internal memory of the HARVEST equipment.

When an instruction that applies to any external device is to be executed, controlling data for that instruction is given to the applicable exchange unit. Exchange will maintain control of this process until the completion of the instruction and, at the same time, HARVEST will proceed to the next instruction in sequence. This operation will permit the simultaneous communication with external devices and computation.

The High Speed Exchange functions (full word assembly and disassembly, error detection and correction, check bit generation, and transfer of information) will apply to the high performance tape system known as TRACTOR. This exchange will permit the simultaneous reading and writing of two TRACTOR tape units, up to a rate of approximately 140,000 64-bit words per second on each unit. Since this exchange unit contains independent Read and Write channels, any one tape unit may be reading, while any other tape unit is writing. At the same time, any tape unit, which is neither reading nor writing, may perform any of the control functions, such as Rewind, Backspace, Forward Space, etc.

The functions of the Basic Exchange are the same as for the High Speed Exchange; however, the simultaneous read-write speed will be a maximum of 23,000 64-bit words per second. The input-output units controlled by this exchange will be the card reader (1000 cards per minute), the card punch (250 cards per minute), the chain printer (600 lines per minute) an inquiry station, the operator's console, and the 729-IV tape units. A number of these external units may operate simultaneously through the Exchange, either reading or writing, the number depending on the speed of the units involved.

TRACTOR TAPE SYSTEM

The TRACTOR Tape System operating through the High Speed Exchange, will have an instantaneous information rate 100 times that of the IBM 727. Information is recorded on 1.5 inch tape, in 22 tracks (16 data and 6 check), with a minimum bit density of 3000 bits per inch per track. Maximum tape speed is 235 inches per second, as opposed to 75 inches per second on 727 tape units.

Tape reels are to be mounted in closed cartridges that are automatically loaded and unloaded on the tape units, by an automatic cartridge handling device under program control.

The TRACTOR tape system cannot be used for the normal tape input and output functions, since there are no facilities for off-line loading of the TRACTOR tapes, or for off-line printing. Therefore, its most general use will be as a high speed intermediate storage.

Information recorded on 1 TRACTOR tape is approximately the same as the information that can be stored on 40 IBM 727 tapes.

729-IV TAPE SYSTEM

The tapes for this system will be half inch, seven track tapes, with a speed of 112.5 inches per second. Recording of information will be at a density of 200 bits per inch, or 556 bits per inch. This dual density will permit communication with any system, or peripheral equipment, using the 727 or the 729-I tape sytems.

OPERATING MODES

Within the HARVEST complex, there will exist two separate modes of operation; the Basic Computer mode, and the Data Stream Processing mode. The system may operate in only one of these modes at any one time. Since it may be desirable to alternate between these two modes modes during the course of a single program, provision is made within the instruction set to accomplish this under program control.

The Data Stream Processor is designed to operate on a sequence of binary configurations in a rapid and automatic fashion. This is accomplished by the simultaneous operation of several independent mechanisms and the sequential processing of data in an asembly-line manner. This processor is like a special purpose equipment, of the "plugboard" variety, in which the operation to be performed, and the parameters to control this operation are stated before any activity begins. This "plugging", or the initial statement of the operation, is made under program control. There is a provision for the programmed adjustment of parameters during the course of the processing. Making a single operation statement will cause a logical and/or arithmetic operation to be performed on any specified amount of data.

The operation of the Basic Computer mode will be a normal sequential execution of instructions of the type usually found in most general purpose computers. Arithmetic and logical operations are performed on single operands taken from memory. The size of this operand will be from 1 to 64 bits.

PROGRAMMING

A program for the HARVEST System will generally follow the programming procedures encountered in any large scale computing device. The program will consist of a series of coded instructions that will be executed in a predetermined sequence. When an instruction is encountered that applies to the Data Stream Processing mode, complete control of the system is assumed by the Data Stream Processing Unit until the instruction is completed.

This instruction may continue for as little as a few microseconds to as long as several minutes, depending on the type of operation specified and the amount of data from memory to be processed.

The format for this Data Stream Processing Unit instruction includes three words within the program sequence for the specification of the basic operation, and determines the path through the necessary mechanisms of the Data Stream Unit. The indexing parameters necessary to control this operation are stored in memory, and are transmitted to a series of special registers prior to the execution of the Data Stream instruction.

Instructions within the system that do not apply to the Data Stream Processor will be executed in the Basic Computer mode. Each operation of this type is completed within a specific number of microseconds. Although instructions within this Basic mode of operation use both a half word (32 bit), and a full word (64 bit) format, they may succeed one another in any order, and Basic Computer instructions may begin at any half word position in memory. Each time an instruction is to be fetched from memory, the instruction counter is incrememted to address the next instruction. When the instruction fetched is half word, the counter steps once; when it is full word, the counter steps twice. This permits the sequential "packing" of instruction, without regard for memory word boundaries.

The set of instructions used to control the HARVEST System is given below:

1. Basic Computer Mode Instructions
   a. Floating Point Arithmetic Operations
   b. Integer Arithmetic Operations
   c. Conversion Operations (Binary to Decimal and Decimal to Binary)
   d. Logical Connective Operations
   e. Index Arithmetic Operations
   f. Branching Operations
   g. Transmission Operations
   h. Input-Output Operations
   i. Miscellaneous Operations

2. Data Stream Processing Mode Instructions
   a. Collating Operations
   b. Table Reference Operations
   c. Stream Transmission and Clearing Operations
   d. Double Input Logical Operations

A contract has been set up with IBM under the covername of FARMBOY which provides for the development of an automatic programming system for HARVEST. This project will provide a machine oriented system, a problem oriented system, and a machine utilization system.

The machine oriented system will be of the assembly type, with a one-to-one correspondence between the source language and the HARVEST instructions.

The problem oriented system will accept a statement in a source (problem) language called TRANSCRYPT, and, after analysis of these statements, produce operating programs for the HARVEST equipments.

The machine utilization system shall accomplish the scheduling and supervision of the operation of more than one program, including its input-output. This will also include a conversion program for the TRACTOR tapes. The main function of this system will be to permit more than one program to run concurrently.

The planning for the implentation of the HARVEST System into the MPRO processing complex is now in progress. More information concerning the plans will be made available at intervals.

The current system configuration is attached.

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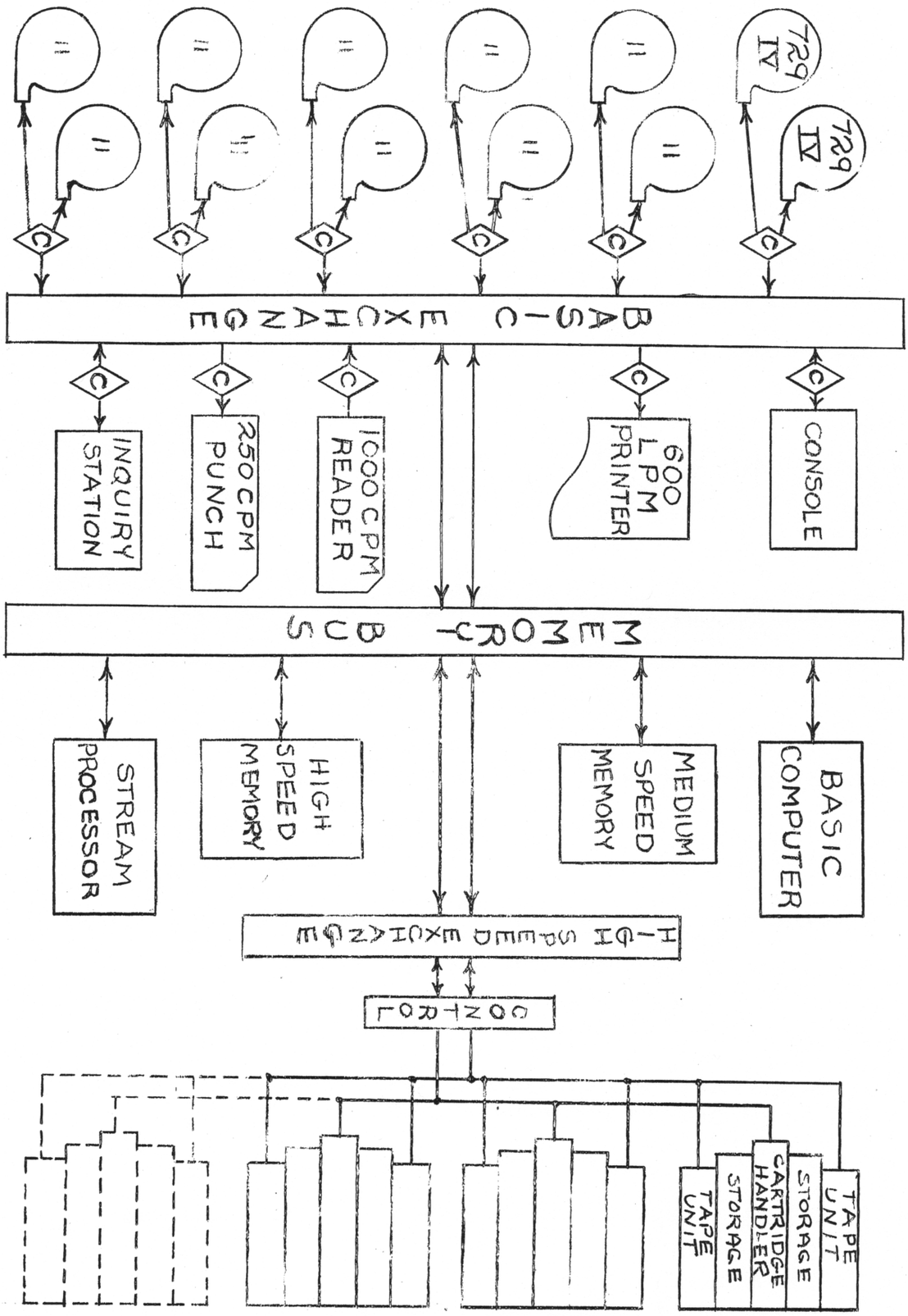

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