NASA TECH BRIEF

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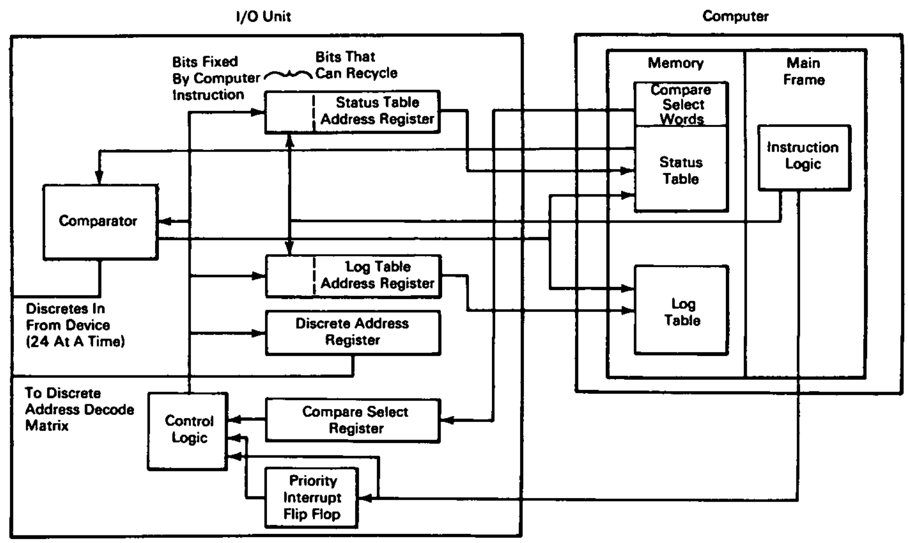
System Monitors Discrete Computer Inputs



The problem:

A large automated checkout system often has a few thousand discrete input lines that require monitoring. The monitoring system must be capable of logging enough current information about the changes so that their history can be reconstructed. Checkout conditions often require the system to recognize the discrete changes. In such cases, a discrete input change must be capable of interrupting the program that the computer main frame is performing in order to take action to service the device being checked. The monitoring and logging must not usurp the computer processing function or memory accesses.

The solution:

The discrete lines are scanned often enough to keep the stored data current. On every scan the present condition of each line is compared with the data already in the Status Table from a previous scan. When a difference is detected, the Status Table is updated. At the same time, the new status, time of compare, and discrete addresses are stored in the Log Table in the computer memory. The I/O (Input/Output) Unit, by virtue of bits stored in the Compare Select Register, will sense which discretes are selected to be monitored.

When special action is required as a result of a change in the selected discrete lines, a Priority Interrupt will be actuated. This actuation will cause the computer to interrupt the program it is performing and jump to a predesignated program whenever a noncompare is found on selected discrete lines.

The computer main frame and memory must be available for other functions. The comparing, addressing, and controlling are therefore performed in logic blocks within the I/O Unit. A single instruction starts the unit processing. Memory accesses are done on a priority basis. Since the discrete data rate of change is slow, the scanning rate (maximum,

(continued overleaf)

limited by memory access rate) need not be at the maximum memory access rate. The availability of accesses for each I/O is determined on a memory access priority basis. The Discrete I/O Unit is assigned the lowest priority. It uses only the memory accesses not being used by other computer functions.

The Log Table length is optionally determined by the computer instruction. When the selected table length is half filled or filled, the computer can be interrupted and be caused to jump to a preselected routine.

How it's done:

A Status Table and a Log Table in the computer memory are used to store data. A table, made up of 63 sequential memory locations, is used to form the Status Table for 1512 discretes. The computer has a 24-bit word. Each bit of the 63 words indicates the status of a discrete. The first word of the table contains the status of discretes 1–24, the second contains discretes 25–48, and so on through the 63 words. This table is updated when the input lines change as the discretes are scanned. The addresses of these memory locations are held in the Status Table Address Register in the I/O Unit. This Address Register is stepped an increment by the Control Logic when the next discrete status is needed. The contents of these addresses of the Status Table in the computer memory are shifted into the Comparator, after which the 24 input discrete lines are gated into the Comparator for the comparison. When the bits from the table and input discretes do not compare, the Log Table is used for storing the information needed to reconstruct the discrete history. Two sequential Log Table locations are used to store this data. The first location contains the present state of the 24 discretes in a single word. The second location contains the 18-bit count of a relative timer and the number of the discrete word (which of 63). The relative time counter used here is a 27-bit counter triggered by a 1-millisecond pulse. Whenever the 19th bit position overflows, 27 bits are stored in the Log Table using 2 sequential Log Table locations.

So that discrete input lines can be selected for monitoring, the 3 words preceding the Status Table are used. The first 63 bits in these words are used to indicate which of the 63 discrete words in the Status Table are selected for comparison with the discrete inputs. In the first word of the 3 words, bit 0 is associated with the first discrete word in the Status Table which holds the status of the first 24 discretes. Bit 'one' of the first word of the three words is associated with the second word which holds the status of the second 24 discretes and so on through 63 bits. A 'one' in any of the 63 bit locations causes the Status Table to be updated and the Log Table to be used when there is a noncompare between that Status Table word and the associated discrete inputs. These bits can be set or reset at any time in order to select or reject discretes for monitoring. These 63 bits are transferred to the Compare Select Register in the I/O Unit for testing by the Control Logic.

A Priority Interrupt flip-flop in the I/O Unit is set by the initial command from the computer. This flip-flop is set when it is desired to have the computer interrupt the program it is performing and jump to a predesignated one when there is a noncompare between the Status Table and input discretes selected for comparison. This condition is required when the device must be serviced after an Input Discrete has changed.

Two separate registers in the I/O Unit hold the computer memory addresses of the Status and Log Tables. The most significant bits of the Log and Status Table Address Registers are set by a single computer instruction. These bits determine the starting addresses of the tables in the computer memory. The least significant bits of the registers start out reset and are counted up as the addresses are used. The quantity of the least significant bits determines the table lengths. The Log Table length can be selected by computer instruction to be 512, 1024, or 2048 words long. Normally, the I/O Unit activity can be terminated by computer instruction at the time this table is half full or full during a program interrupt. The Status Table length is selected by jumper wiring on a terminal board. This is feasible because the number of discretes are usually fixed in a system. Both Address Registers recycle when the length that was selected is filled.

The program interrupt and memory access priority systems are part of the computer main frame capability. Two command words are used to initiate the I/O Unit. These words set the Table Addresses, Log Table length and type of monitoring.

Note:

Inquiries concerning this innovation may be directed to:

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No patent action is contemplated by NASA.

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