The Ames Laboratory Interactive Hardware
Programmed POLLY

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ABSTRACT

This paper presents operational concepts concerning the amount of computer control required to select, gather, and display data in a POLLY System. An attempt is made to minimize computer interaction by incorporating outboard parallel processing function controllers. These function controllers are hardwired program subroutines to which the main software program can pass the desired parameters.

Necessary system status information is presented to the operator through a lighted panel as well as a video display. A built-in computer simulator is used to facilitate checkout and maintenance.

Logic design of the digital controllers and video display will be discussed.

The High Energy Physics Group of the Ames Laboratory, Iowa State University, is currently measuring bubble chamber film using three independent manually controlled film measuring machines. These machines are interfaced to an ASI 6050 computer. The computer system includes 16K core memory, a 5 megabit drum, 9 track magnetic tape unit, card reader, and a model 33 teletype at the console. One prerequisite in changing to a POLLY type measuring system was to use the above hardware and hold additions to a minimum. The expansion of the computer system is in secondary memory, a 10 megabit drum to replace the 5 megabit drum. Using the drum as secondary storage for incoming data and as a program file, a core overlay technique will be employed to expand the capabilities of this computer system. Channel assignment of peripherals and HOLLY control hardware is shown in Fig. 1.

With the system configuration finalized, a hard look at system performance revealed the fact that the computer is extremely compute bound. The scanning method employed by the POLLY system requires the computer to direct a scanning spot across a track while at the same time collect information resulting from that scan. Controlling spot programs and data stuffing robs the computer of required computing time and it is obvious that the scanning hardware would be sitting idle while computational needs are carried out. To relieve the computer of input/output requirements, as many scanning and gathering operations as possible were transferred to controllers external to the computer.

The method of scanning is shown in Fig. 2 and is called a slice-scan. By supplying a set of parameters to an outboard scan-controller the computer is freed from the task of actual spot deflection and a complete slice-scan can take place independent of computer control. The parameters required to perform a slice-scan are as follows:

function	number of bits
major axis x starting point	24
major axis y starting point	24
major axis x stepping increment	23 + sign
major axis y stepping increment	23 + sign
number of base line steps (slice-scan length)	8
major axis x pincushion correction increment	16 + sign
major axis y pincushion correction increment	16 + sign
minor axis x stepping increment	12 + sign
minor axis y stepping increment	12 + sign
number of sweep steps (slice-scan width)	9

These ten parameters specify the slice-scan raster and they are presented to the scan-controller in ten computer words in sign magnitude form.

The desired result of a slice-scan operation is the center of gravity of the bubble track within the scanned area. To supply this information using outboard hardware is a considerable duplication of computer capabilities; however, a summation of bubble crossing information is realistic. Much like the scan-controller solution, a data-summing-box is placed outboard from the computer and as the slice-scan proceeds the data-summing-box collects the track crossing data and condenses the hundreds of data words into five computer input

Fig. 1 HOLLY Film Measuring System

Fig. 2 Slice-Scan Raster

parameters. These five data parameters, as shown in Fig. 3, are then used by the computer to determine the center-of-gravity of the previous slice-scan.

parameters
summation of valid track sweep numbers
number of valid track crossings
number of invalid track crossings
summation of valid track ordinate values
summation of valid track bubble widths

If the controlling programs so desire, the data-summing-box can be bypassed and a more detailed look at slice-scan data can be obtained.

Various additional functions are implemented by the data-summing-box such that controlling programs can specify acceptable bubble track widths, focus the spot, set discriminator levels, and set a noise filter parameter to compensate for poor film quality.

Now for each slice-scan the computer transmits 14 words over the channel and receives five words back at the end of the slice-scan. This channel communication proceeds on an asynchronous bases and reduces control requirements by two orders of magnitude for the average slice-scan.

A lighted display panel indicates the status of these outboard controllers. This display and a data channel simulator were invaluable aids in initial checkout and will be used to good advantage for trouble shooting in the future should hardware malfunctions develop. Both controllers are clock driven at 2 megahertz; however, a manually operated push-button clock is wired in for test purposes.

System overhead is further reduced in CRT communication. Outboard character and vector generators lower channel requirements to a minimum. Characters are presented to the outboard character generator in ASCII format packed three characters per computer word. These characters are unpacked and displayed by the outboard generator. A single computer word is all that is all that is required to draw a variable length vector, or to position to any point on the screen. The display data field in core is a variable length record with character and vector blocks intermixed. When the controlling program wishes to implement the CRT display a control signal is sent to the unit. If ready the display unit will answer with a refresh interrupt and the controlling program will assign the active display field to the I/O channel. When this field is exhausted the I/O channel will disconnect automatically. At refresh time the display will interrupt again. The controlling program has the freedom to change or update the display data within the field whenever it so desires.

The display of the cursor spot on the CRT screen appears as crossed straight line vectors and is implemented using the vector generator hardware.

This POLLY system is a four view system with control features which allow projection and film movement in all four views simultaneously; however, film measurement can only take place in one view at a time. A three speed cursor control and a 48 function lighted switch panel provide operator-computer communication.

Fig. 3 Slice-Scan Data Parameters