AUTOMATION OF BESSY SCANNING TABLES.

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ABSTRACT.

A micro processor M6800 is used for the automation of scanning and premeasuring BESSY tables.

The tasks achieved by the micro processor are :

1, control of spooling of the four asynchronous film winding devices and switching on and off the 4 projection lamps,

2, pre-processing of the data coming from a bi-polar coordinates measuring device,

3, bi-directional interchange of informations between the operator, the BESSY table and the DEC PDP 11/34 mini computer controling the scanning operations,

4, control of the magnification on the table by swapping the projection lenses of appropriate focal lengths and the associated light boxes (under development).

In connection with point 4, study is being made for the use of BESSY tables for accurate measurements (+/- 5 microns), by encoding the displacements of the projection lenses.

1. Introduction.

The laboratory for Elementary Particle Physics at the University of MONS is equiped with 6 scanning tables (SFAT - BESSY type) with manual bipolar coordinates devices originally with output in BCD format on paper tape. It has been found necessary :

a. to automatise various operations as : film displacements, change of optical magnification, change of view, preprocessing of the encoders data, ...

b. to connect them to a DEC PDP 11/34 computer, so as to assume the guidance of the scanning, premeasurements and interpretation operations.

The project has been studied first by means of an AMI S6800 development system (MOTOROLA M6800 micro processor), and followed by the construction of a hardware prototype in view to demonstrate the feasibility, to acquire the necessary experience and to define the actual needs. The final step (automation of the 6 tables) has been achieved by using a MOTOROLA M68MM01A micro module and a wire wrapped board containing the interface extensions needed by our application.

2. BESSY tables

2.1. Projectors : each table is equiped with 4 film winding and projection devices. Manual operations are initiated by a keyboard with predefined functions : continuous spooling, advance frame by frame or by 1/5 th of a frame, ... These operations are then executed by the associated electronics and the pictures displacements are monitored by 4 photo cells sensing the cabstans rotations (5 pulses per turn corresponding to a picture length of 95 mm).

2.2. Coordinatometers : the coordinatometer consists of two rotating encoders located at two fixed poles and connected by thin wires to a reference cross which can be moved to any point of the projected frame on the table. The distance between this point and each pole is measured in 1/10 th of mm increments. The encoders data are transfered to bidirectional counters, allowing a digital display of the coordinates.

3. Simple automation procedure.

3.1. Projectors : the simplest and fastest solution of the problem is to replace the manual keyboard by a micro processor equiped with an interactive device (video display unit), with the advantage that the positioning of the film to any preset frame is easily feasible. In that case, the micro processor computes the number of frames to be spooled, the spooling direction and then simulates the commands corrsponding to the manual keyboard. By counting the pulses coming from the photo cells, the processor knows the actual position of each roll and stops the winding motors when the desired pictures are correctly positionned.

3.2. Coordinatometers : their connections to the DEC PDP 11/34 mini computer is achieved by adding 3 parallel interfaces (PIA M6820) to the micro processor used for the control of the projectors. These parallel interfaces allow a non multiplexed entry of the bipolar coordinates (5 BCD digits each), the view and slice number and also the validation of the data (foot pedal). A serial interface (ACIA M6850) is used for the connection of the micro processor to the PDP 11/34 DL11 serial controller by a passive 20 mA current loop at 4800 bauds.

3.3. The scanning instructions are coded in an interactive program and the operator introduces through the keyboard the sanning informations as these instructions appear on the VDU screen. The same interactive VDU is used for the scanning and the control of the projectors, some special characters allowing the switching from the conversational mode to the projector command operations.

4. Mini-micro computers network.

Figure 1 presents a diagram of the mini and micro computers network used for the analysis of high energy events and for software development (technical description of the material is given in the appendix).

4.1. The micro computer used for the connection between the PDP 11/34 and the BESSY table (described in chapter 3) is presented in figure 2.

4.2. The AMI development micro system, used in the first step, is now reserved for the control of the mini computers PDP 11/34 and PDP 11/40. Moreover it is used for the burning in of EPROM memories according to the following operations : the MOTOROLA software is developped on the PDP 11/34 using a cross assembler (written in the lab) and the object versions are transferred into the RAM of the development system, and then in the PROM programmer.

4.3. The new development device is used for the study and the setting up of new projects, for example : the control of coded displacements of projection lenses and graphic applications.

5. Conclusions.

The use of micro processor modules has thus enabled us to automatise very easily the scanning and premeasuring devices in use in our lab and this at a relatively low price. Such a solution offers so an economical alternative to the use of more elaborated systems, with of course the necessity to develop the corresponding software (generally in assembler language).

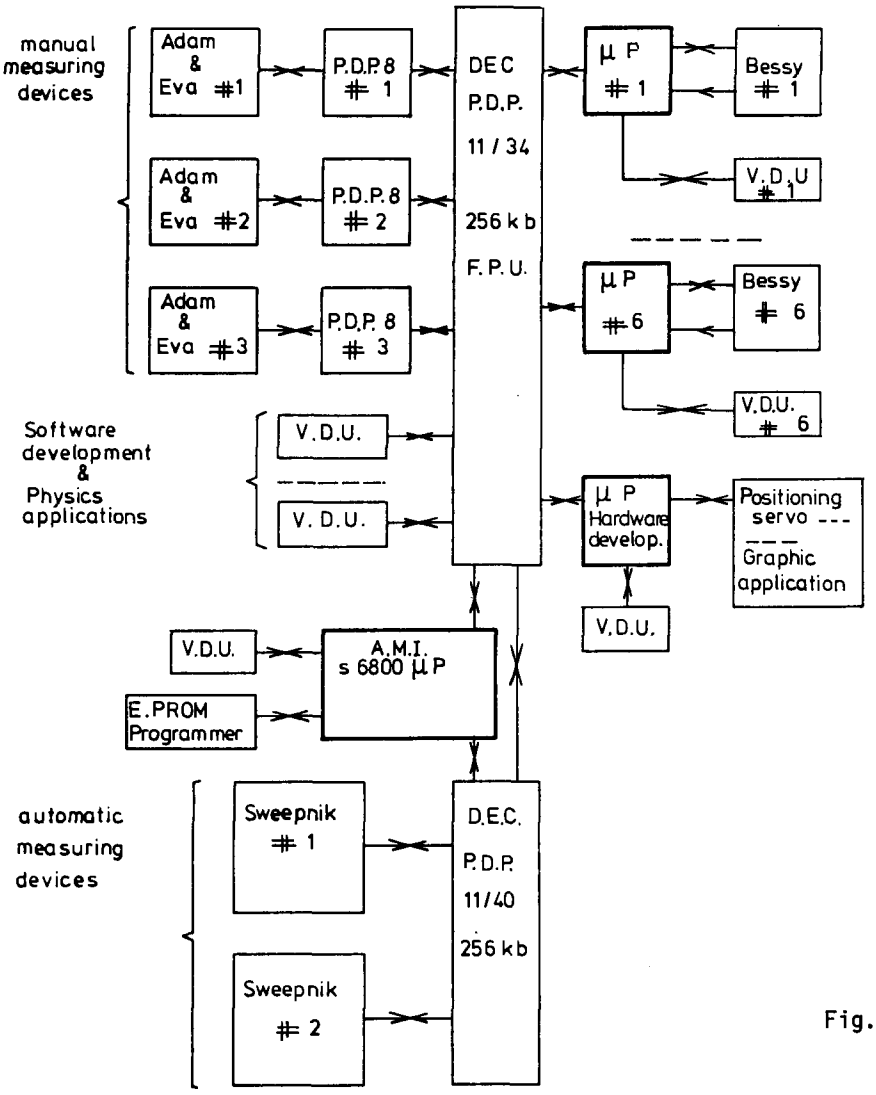

Fig. 1

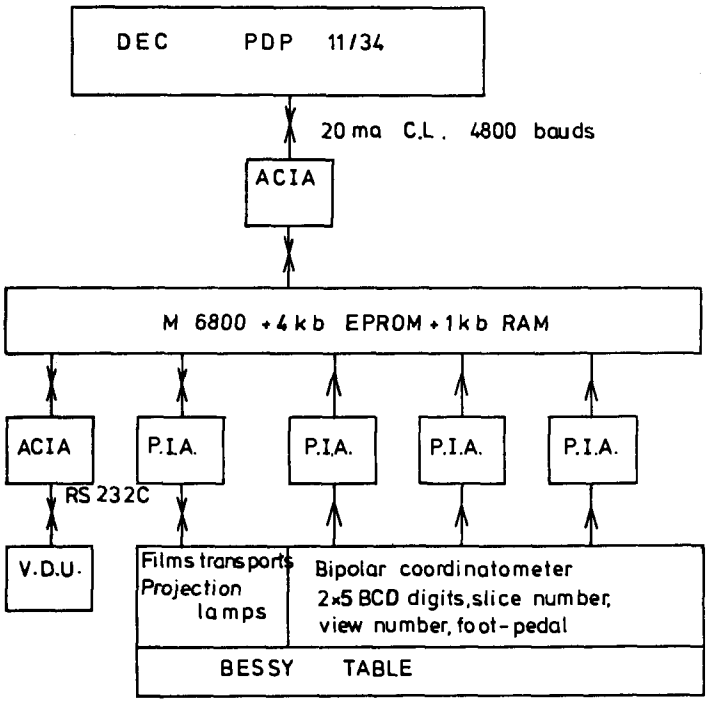
DEC PDP 11/34
20 ma C.L. 4800 bauds
ACIA
M 6800 +4kb EPROM+1kb RAM
ACIA
P.I.A.
P.I.A.
P.I.A.
P.I.A.
RS 232C
V.D.U.
Films transports
Projection lamps
Bipolar coordinatometer
2x5 BCD digits, slice number, view number, foot-pedal
BESSY TABLE

Fig. 2

APPENDIX

1. Microprocessor "BESSY".

1 board M68MM01A

- processor M6800 (1 MHz)
- 1 K RAM (128 bytes used)
- 4 K EPROM (2 K used)
- 1 ACIA (RS232 -> vdu)
- 2 PIA (1 used for film transport and projectors)

1 extension board

- 3 PIA (coordinatometer)
- 1 ACIA (current loop for PDP 11/34)

2. microprocessor "AMI".

1 board AMI S6800

- processor M6800 (1MHz)
- 1 K RAM
- 2 K EPROM
- 1 ACIA (VDU)
- 3 PIA
- prom programmer

extension boards

- 8 K RAM
- 2 ACIA (PDP 11/34 and PDP 11/40)
- 3 PIA

3. Microprocessor "electronic development and maintenance station".

- 1 board M68MM01A
- 1 board 9626 (8 Kb RAM)
- 1 board M68MM04 (16 Kb EPROM)
- 1 universal board MEX68USM
- 1 board M68MM06 (2 K RAM)
- 1 extension board 5 K RAM
- 1 extension board as in BESSY (3 PIA + 1 ACIA)
- 1 MATROX EXO 512 graphic interface
- 1 MATROX EXO 2480 alphanumeric interface
- 1 board 9640 multiple programmable timer.