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BEAM LINES CONTROLS SYSTEM for SATURNE II

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I. Introduction -

Computer control around SATURNE II deals with two distinct systems : one affects the accelerator itself, the other monitors the beam lines used by the physicists. The latter will be the subject of the present paper.

The transport of beam particles is obtained by bending magnets, focussing quadrupoles and adjustable collimators. Various detectors along the beam path allow acquisition of geometrical quantities (position, angles, emittance) and physical parameters (nature and momentum of particles) of the beam.

The computer control of the beam lines will have to provide the following functions :

- a) Allow the various experimenters sharing the use of the machine to set properly the parameters required in their apparatus. Some complex operations will have to be automated (beam focussing, tuning of coincidence circuits, etc..).

- b) Monitor the stability of various parameters, with provision for correcting slow drifts.

- c) Should a major incident occur, on a particular piece of equipment, provide the person in charge with a detailed survey of defects in order to facilitate troubleshooting.

- d) Take care of anciliary tasks, like mapping of magnetic fields of magnets, for example.

- e) Work as a batch processing computing center for small jobs written in high level language (Fortran).

II. Equipments to be monitored -

Three types of equipment shall be considered, depending on the physical location.

- a) Magnet power supplies and their auxiliaries (cooling system, etc..).

- b) Equipment located on the magnets themselves (defect detectors, NMR probes..)

- c) Miscellanous detectors located along the beam lines or being part of the experimental set-up.

Terminals are located in the accelerator's control room and in the physicists trailers to provide dialogue between the users and the system.

Those various pieces of hardware are scattered in various part of the experimental area, with data links to be provided over distances of the order of 100 to 200 meter.

III. Overall organization of the system -

Many of the operations to be performed on the equipments are repetitive and automatic. It was thus felt they could be trusted to the care of a microprocessor.

A central computer, well provided with peripherals will insure the transmission of the orders issued from the users terminals and the exchange of information between the various microsystems. It will also assume the function of program library and of data bank.

Such an organization insures a better reliability, as each microsystem is able to run on its own for a while in case of a temporary unavailability of the Central unit.

Besides, some microsystems will be able to be completely disconnected from the central unit while performing purely local tasks.

IV. Hardware organization -

A/ Choice of equipments -

The surroundings of an accelerator is under constant evolution to adapt to the ever changing requirements of the physicists.

This brought us to use the Camac interface system, as it seems the most able existing system with the versatility needed to adapt itself to such an evolution.

The central processing unit is a MITRA 125 with a 28 K memory, a 10 Megaoctet disk memory, a card reader, magnetic tape units and a lineprinter. It is connected to a Camac interface system by a coupler built at Saturne.

A JCAM10 microcomputer designed by the Service d'Electronique de Saclay has been chosen for the satellite systems. This unit, build around an INTEL 8080 integrated circuit combines the functions of microcomputer and Camac controller, with up to 4 crates capability.

Because of the length of the links involved, serial data transmission has been chosen Special crate controllers were developped for that purpose using coaxial cables at a rate of 5 MBaud.

The coupler connected to the MITRA serves 64 crates (4 branches of 16 each). The maximum possible distance between two consecutive crates is 300 m.

To insure communication between the MITRA 125 and the microcomputers, several of the serial Camac controllers and corresponding JCAM10 microcomputers share the CAMAC bus of particular crates.

B/ Geographical location -

The central processor unit and its peripherals are installed in the vicinity of the accelerator control room. The CAMAC crates are clustered in various locations, each station serving the needs of the equipments around it.

The transmission of orders and of information between those stations and their respective equipments is performed also in serial mode through a CAMAC plug-in unit.

Dialoguing of the users with the system occurs via alphanumeric keyboard and visualization units connected through CAMAC interfaces to the nearest station.

Graphical displays (memory scopes) are provided for particuliar applications.

CAMAC is also used to hook up the whole system with the on-line computers brought on the floor by the experimenters.

A simplified layout of the system is shown on figures 1 and 2.

V. Software -

The software of the MITRA 125 is well suited to multi-user operation.

However, important adaptations are to be introduced when operation with a CAMAC system is required.

The Fortran package offered by the MITRA 125 was found efficient enough for our real time application, and seemed to yield quicker results than some better adapted language like NODAL (unfortunately not provided with the MITRA).

"DATA MODULES" library subroutines matched to every particuliar equipment allow Fortran programming of all the peripherals. Those subroutines are in assembly language and execute all the CAMAC instructions needed for command and acquisition with the corresponding equipments.

The programming of the microsystems JCAM 10 has to be done in assembly language, by means of a crossed macro-assembler specially designed for that purpose on the MITRA. This assembler, geared to the INTEL 8080 microcomputer generates a translatable binary code accepting external definitions and references. An editor-loader has been developped on the INTEL 8080 to enter the binary programs so generated.

We are presently considering a Fortran compiler specially adapted to this microcomputer.

Conclusion -

The system we have described is not fully implemented yet, as the accelerator will only be operational some 18 months from now.

This allows room for necessary improvements from the presently planned organization.

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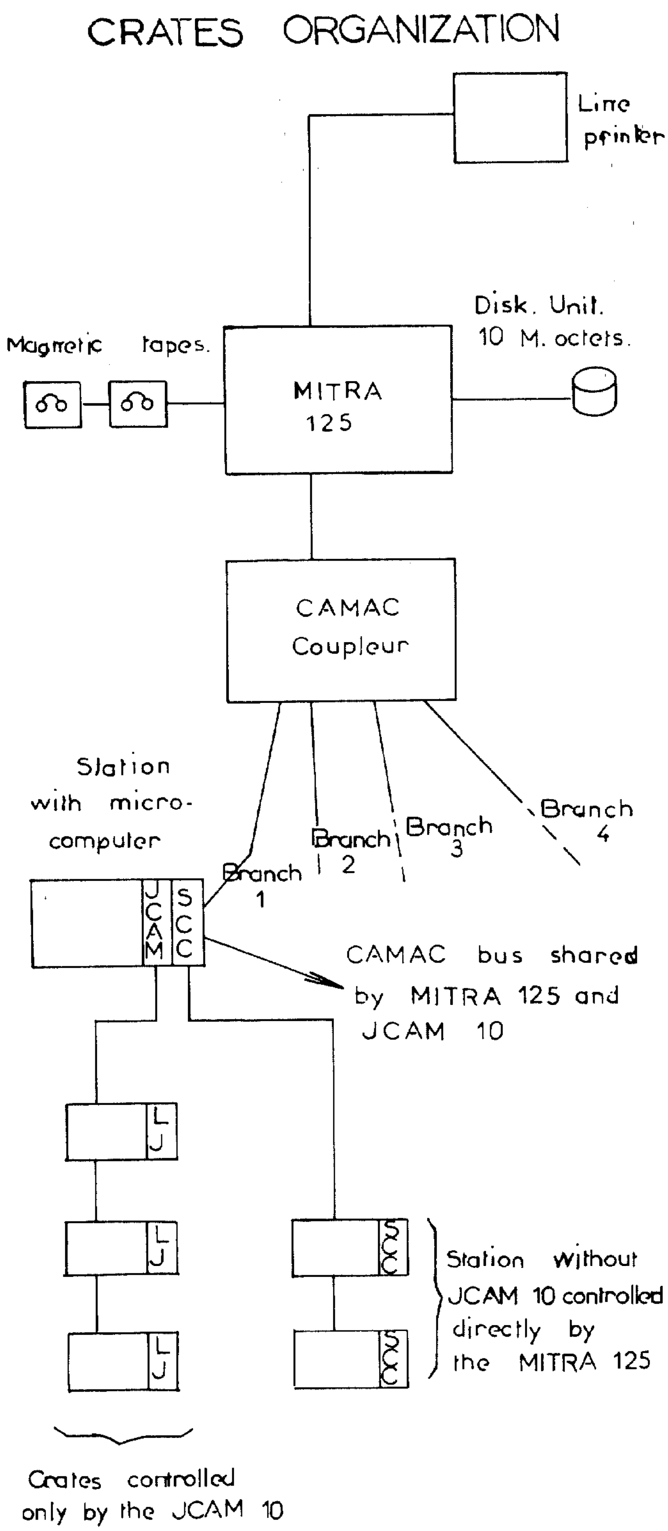

Figure 1.

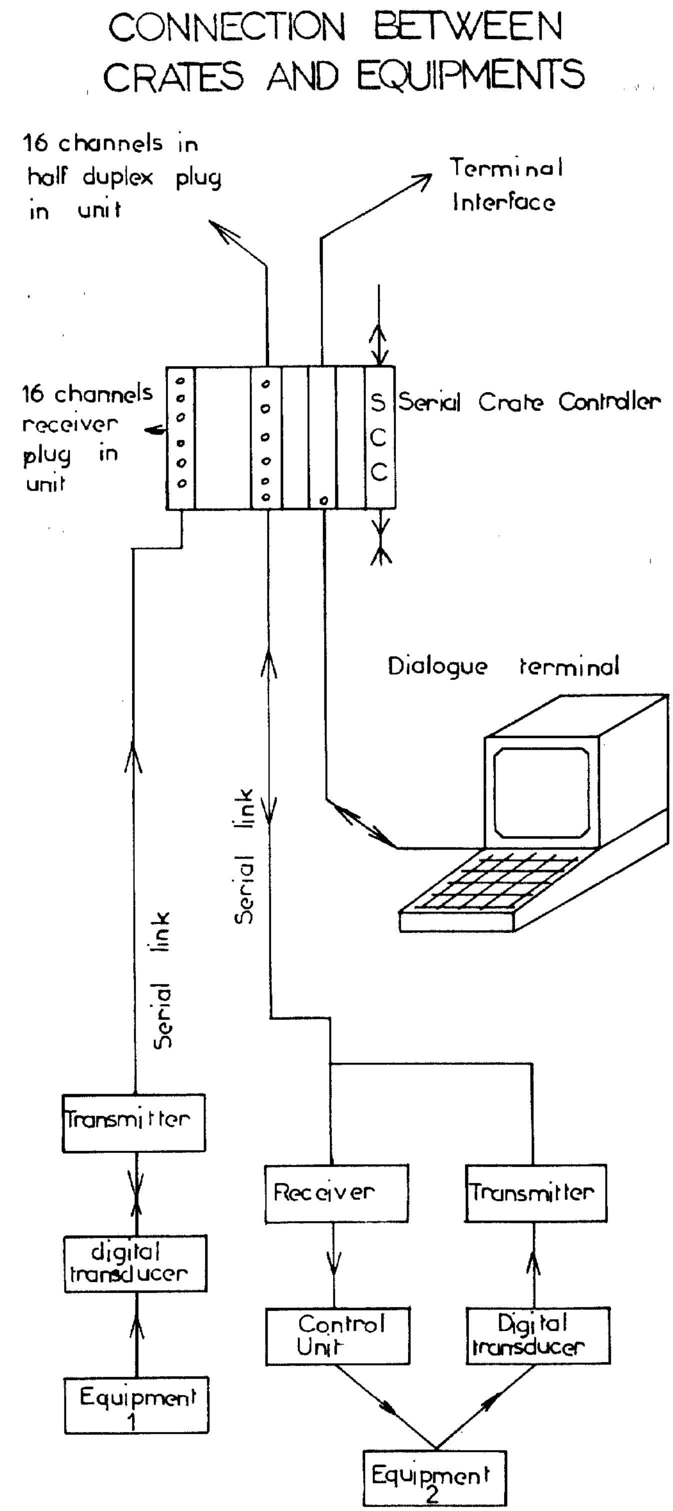

Figure 2.