SECTION 4 THE CONTROL SYSTEM

Summary: The present control system has matured both in terms of age and capacity. Thus a new system based on a local area network (LAN) is being developed. A pilot project has been started but, owing to difficulties encountered with the present operating system used with the microprocessors, it has become necessary to reconsider our choice of operating system. A recently-released multi-tasking operating system that runs on the existing hardware has been chosen.

Development of other projects within the group is proceeding satisfactorily.

4.1 System Development

The present minicomputer-based control system has reached maturity both in terms of age and capacity. It is now approximately ten years old and has grown to the point that the computers provide processing speed which is only just adequate, and the number of processes running on the system has now reached the maximum acceptable limit.

The architecture of the system dates from the late nineteen seventies and is thus now proving deficient both in terms of desired capabilities and when compared to those available from the newer systems that can be built from current technology.

We have thus decided to develop a LAN-based control system using the IEEE 802.3 (Ethernet) standard.

4.2 Developments on the Minicomputer Systems

The hardware of the system is now stable, while software development is now confined to improving the reliability of the system and accommodating changes in the configuration of the instrumentation on the cyclotrons.

The maximum number of programs that can simultaneously be resident in the memory of the computer has been approached. An attempt has therefore been made to reduce the effects of this limitation by combining several of the programs that control the power supplies. This has allowed other programs that are important for effective control to be included.

4.3 Microprocessor Developments

4.3.1 Ethernet communications

Implementation of the Ethernet communication under the disk operating system DOS has proved to be unsatisfactory, as DOS is neither multi-tasking nor re-entrent. These limitations have so far hampered development of the new control system and caused the division to look again at available hardware and software in order to develop an effective and reliable system.

4.3.2 Microprocessor systems

It has become obvious from the experiences mentioned above that a multi-tasking, real-time operating system is necessary for an effective control system. Three alternatives were considered with their corresponding hardware environments. One system unfortunately proved to be unusable because it does not support the IEEE 802.3 standard.

While the other system offers superior performance in the real-time environment, its graphics functions are more primitive than those offered with the system that was finally chosen. The software and corresponding hardware of the latter offer more attractive pricing than competing systems. Thus the Division has decided to standardize on the OS/2 operating system running on an 80386-based AT compatible motherboard which offers good performance for its price.

Fifteen of these hardware systems have been built in-house and currently run under the DOS operating system. The software is being upgraded to the OS/2 operating system which has just become available. One of these systems is shown in figure 1.

Fortunately the flexibility of the LAN philosophy does not preclude the use of alternative systems should circumstances require it.

The chosen hardware is also compatible with the microprocessor hardware that is already in use, thus no new development is required for the existing interface standard.

4.3.3 Microprocessor interfacing

The development of the input/output interface standard based on the SABUS is now complete. A full set of modules is available that are functionally similar to those of the CAMAC modules that are currently in use. In many cases the functions of the new modules have been modified from those of the CAMAC modules to suit our application more effectively, resulting in the use of fewer modules to control the same hardware.

This I/O system is interfaced to the personal computer (PC) compatible microprocessors via a differential bus, thus allowing several instrumentation chassis in one locality to be controlled by a single microprocessor system.

4.4 Applications

4.4.1 Power supply controller

No further expansion of the existing control system is possible for the control of power supplies. Thus a microprocessor-based controller has been developed to control the power supplies used in the magnetic field mapping projects for the main magnets of the spectrometer and SPC2. This is serving as a pilot project for the new control system, both as an operator's console and as a LAN-based computer system. Because of the problems mentioned earlier, the LAN has not yet been incorporated into this system.

4.4.2 Safety interlocking system

The changes envisaged in the previous annual report have been implemented in a modified form. The split between message display and monitoring has been done in software with the latter being written in assembler language to obtain maximum speed. It is scheduled at regular intervals and is linked to a display program written in Pascal. The latter allows the operator to display a sub-system with its status and alarms as well as the relevant interlock equation.

4.4.3 Control of rf-systems

Control of the three rf sub-systems, namely the SPC1, SSC and buncher/ pulse-selector sub-systems, has now been fully implemented. The full program now requires overlays but this has not proved to be a disadvantage as a RAM disc has been implemented which stores the overlay files at run time.

A watchdog timer has also been implemented for the rf processors which automatically reboots the system on failure. This is enhanced by the addition of a facility to log system parameters on a regular basis. Thus recovery on system failure includes the automatic loading of the last set of logged parameters to restore the system to its previous operating state.

The next phase is now under way to link these systems to a PC compatible microprocessor which will link to the new control system. It will also collect maintenance data on a regular basis in order to detect short and long-term changes to the systems.

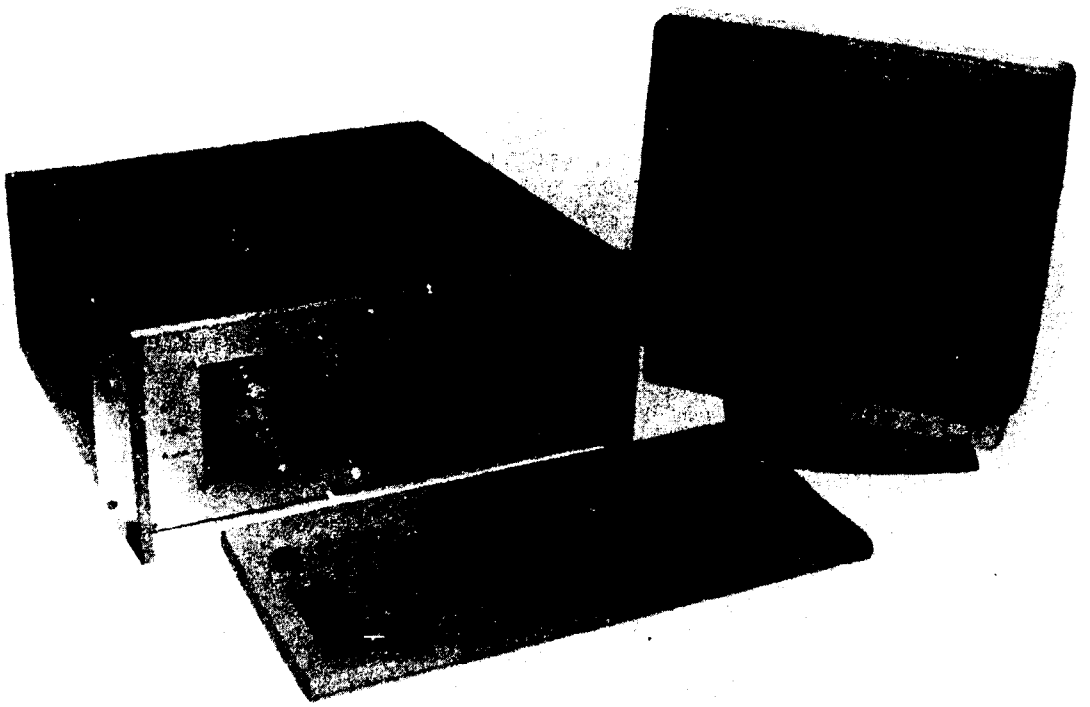

Fig. 1 One of the series of 80386 AT-compatible microcomputers which has been constructed in-house.