Synchrotron Control System

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The Synchrotron control system [1] is constructed with 5 workstations and 14 VME systems. A DEC 4000-720 is the main computer (we call the synchrotron computer) and all control processes are running at this machine. Two DEC 3000-300X are used for operator's consoles. These 3 workstations are located in the injector control room. Two DEC Alpha Station 255/233 are located in the central control room and are also used for operator's consoles.

The Operating system of DEC 4000-720 is OpenVMS AXP 6.1. We developed control applications on POSIX environment (POSIX for OpenVMS AXP 2.0-0.3), because in this mode, we can use sh commands which is more familiar for us, instead of DCL commands. The C language is used for applications programming.

The communication protocol between workstations and VME systems are TCP/IP. We use UCX 4.0 which is DIGITAL TCP/IP service for OpenVMS products. The synchrotron computer communicates with VME by using socket. The connection is requested by the synchrotron computer. If any messages are not sent to VME, keep arrive messages are sent at fixed periods to keep on the link between the synchrotron computer and the VME. If the synchrotron computer does not receive any message from VME in this time interval, the link should be considered to be failed and the synchrotron computer should retry to recover the link.

The synchrotron computer is watching the condition of each machinery at fixed periods. When condition is changed, VME send to synchrotron computer that new condition. So, always correct conditions of machinery are stored in shared memory data. We prepared the API functions to access this data easily. Each task in synchrotron computer communicates by using message queue.

For developing the operator man-machine interface,we decided to use Motif based GUI developing tool, EASYWIN 1.3-007 by DEC. The EASYWIN provides EasyEditor to create window parts, EasyDriver to create application C programs and EasyServer to run applications. The EasyDriver consists of only 9 functions, for example, EasyOpen, Easy Close, EasyRead and EasyWrite.

Figure 1 shows the relation of control windows. Practically, after the machinery selected, we can start to operate simply pushing start button at over view window. Whenever needed, each machinery can be operated at individual windows.

Corresponding to the each monitor, there are 9 monitor windows. Vacuum monitor window can display real-time vacuum pressure of 36 nude ion gauge and 6 CCG. BPM window is used to get 80 BPM data and to display it.

Each magnets and each vacuum machinery can be operated by selecting from machinery list. The ramping pattern of BM, QF, QD, SF and SD magnet can edit visibly. RF system is very complex system and we prepared 7 windows for it. For stable operation of RF cavities, RF conditioning is required. We made auto RF conditioning system. This is very useful and 24 hour RF conditioning is available without operator. First version was worked at RF test station where RF system was controlled by personal computer and CAMAC system[2]. We adopted the algorithm to our systems.

For Orbit control, we made the Sensitivity Matrix based C.O.D. correction[3]. First, The sensitivity of orbits was measured by changing each 80 correction magnets. The S-Matrix was calculated by these data.

The failures of machinery are protected by hardwired system and are also taken into the synchrotron computer. When failures are occurred, power sources are stopped and color of the alarm window is changed to red.

The commissioning of synchrotron was finished successfully using this control system. Now we planned to replace the synchrotron computer to more powerful machine, and to introduce the database system.

References

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[3] H.Nishimura et al., LBL-36443 (1995).

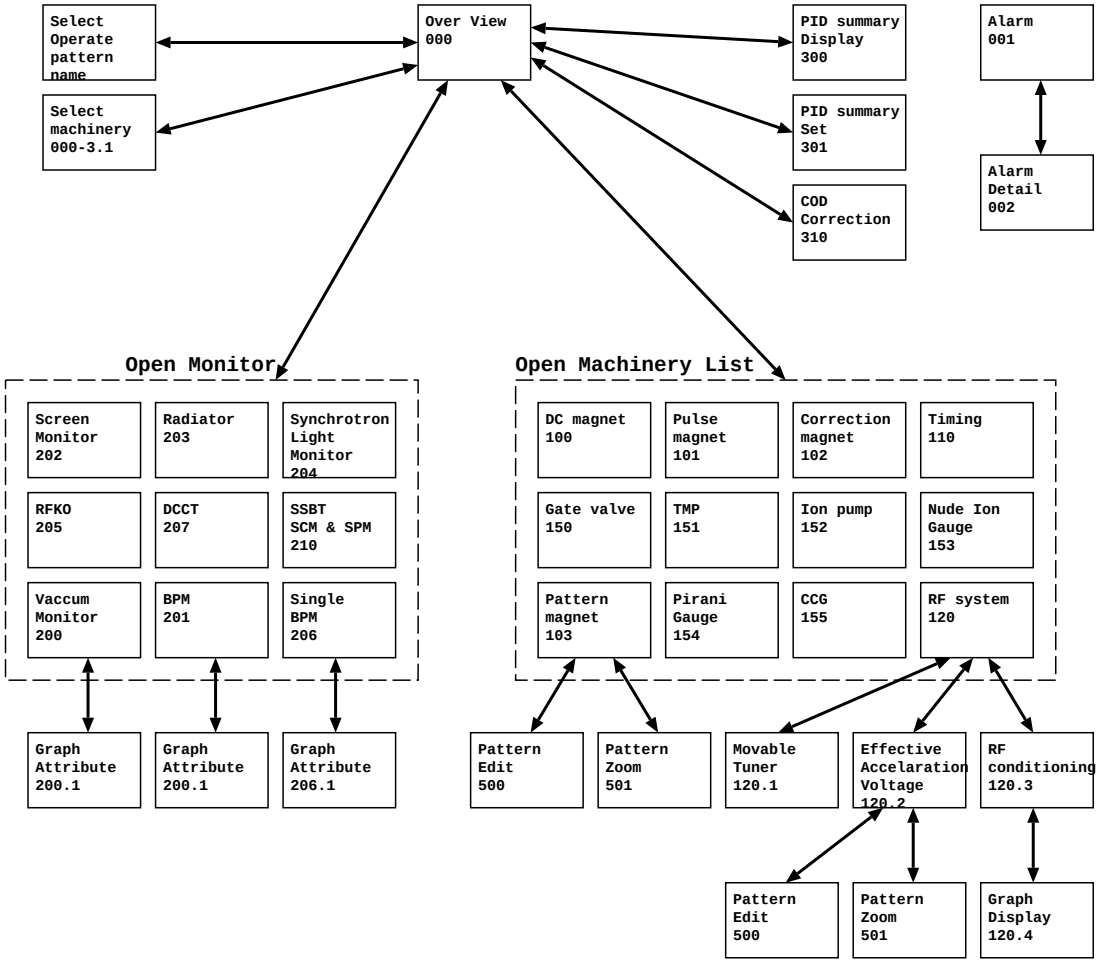

Fig.1 Relation of control windows