THE MACHINE CONTROL SYSTEM OF THE SIAM PHOTON SOURCE: WORK EXPERIENCE

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Abstract

A PC-PLC control system used in the Siam Photon Source is described. Some inconvenience or bugs in the originally built control system have been improved. The magnet control is found to be greatly beneficial from this newly designed system. Part of the timing system was replaced with standard NIM modules but has yet to be fully integrated with the control system. An extra PC was installed to act as interface between PLC and older systems such as a slit, pattern memory, digital multi-meter and video switcher. Software polling technique is used to initiate a request to the devices.

Problem of the slit control was solved by the modification of the communication technique on this intermediary PC. The status of other aspects of the control system is also described.

1 INTRODUCTION

The first synchrotron radiation source of Thailand is the modified SORTEC accelerator system that was owned by the SORTEC Laboratory in Tsukuba, Japan [1-4]. The system consists of a 1.0GeV storage ring, a 1.0 GeV booster synchrotron and a 40 MeV injector linac, along with the beam transport lines between those components.

The old control system utilizing mini-computer, RS-232C and VME interface was abandoned and the new control system was installed by Toshiba Corp, Japan. The new structure was designed to have Devices Control Station (DCS) in stalled and connected to control room through Ethernet. Hardware devices are connected to PLCs located inside the DCS. Personal computers (PC) are used for Man Machine Interface Stations (MMIS) based on NT platform. New timing system was made and replaced part of the old timing system [5]. Standard NIM modules and digital delay generators were used to build this new timing system

2 DEVICE INTERFACE

All magnets power supply is connected to standard module of PLC in the DCS located around the facility. The magnet control system is greatly benefited from this newly designed PC control system. Site-wide magnets power supply such as bending magnets, steering magnets, bump magnets, kicker magnets and quadruple magnets have been connected to the DCS around the facility. The setting of magnet’s current can be easily manipulated using Windows based PC running NT and RSVIEW software. The reliability of the system is found to be exceptionally good. A control server PC (CNT-SRV) is added for the control of some devices that cannot be connected directly to the DCS. This extra PC is installed to act as an interface between PLC and other systems or devices that required RS232 or GBIP interface. The examples of these devices are slits, pattern memory, current-monitor via digital multi-meter and the newly built timing system. Placing logic 1 in the designated location in the PLC does the request for the service of these devices. This request is acknowledged by CNT-SRV who is scanning the above memory area repeatedly at a rate of one time per second. Except for digital multi-meter, which is scanned at a rate of three times per second. The operation is then performed under the control of this PC. Once the operation has been complete CNT-SRV will then place result or error code in a separate memory location in the PLC. However, the response time of such interface technique is found to be slightly slow. This is due to the fact that polling technique is used to detect the request and then a DLL is called to start the operation through either RS232 or GPIB, which is known to be very slow.

The hardware controlling the slit arms accepts commands only through RS232C port extended by optical converter devices. Software bug was found in the feed back loop, which cause the problem for the slit movement. It was later modified to read the arm’s position via PLC and send only the movement position through RS232C as shown in Fig 1.

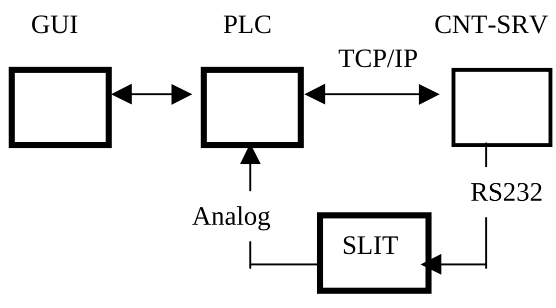

Figure 1. New slit control system

The reading of beam current in the Synchrotron is done by digital multi-meter connected to CNT-SRV via GPIB port. As the reading is made three times per second this is thought to be the reason that frequently cause CNT-SRV to report communication error. This technique is now complemented by reading beam current through Analogue-to-Digital (A/D) module in the DCS, which is also found to gives more stable readings than using digital multi-meter. The communication between CNT-SRV and pattern memory is also done via GPIB port extended by optical converter devices. No serious problem has been found except when there is a power line failure, which sometimes causes an error in communication. At the moment this problem is solved by turning off devices at both ends.

Part of timing system was replaced by standard NIM modules and digital delay generator and integrated with the older part, which is the pattern memory for the Synchrotron. The control of newly built timing systems is done by the connection through PLC. The interface for trigger signal can be achieved by using only 1 bit digital interface from the PLC to start or stop the counter. The system for bunch selection however, requires an additional circuit to interface with the VME port. Manual adjustment of delay generators is going to be replaced with computer control through CNT-SRV using GPIB ports.

The vacuum control unit in the storage ring is not fully integrated with the new control system. This old system is running on an old PLC module. Only one fault signal is coming out of the old vacuum control unit but we ignore it. The modification cannot be made to this PLC module as the old circuit drawing and software has not yet been located. The planning has been made to upgrade the system to match the new concept of the control system. At the moment the control of storage ring vacuum system has to be assisted manually.

The control of storage ring operation by computer was almost trouble free except for RF power supply, where the control of tuner position and tuner angle could not be set up properly. The problem was later solved by fixing the software flaw in the conversion of monitored value in the DCS.

3 DATA ACQUISITION AND DISPLAY

Data acquisition server (ACQ-SRV) is install for the purpose of collecting site-wide information. The server is also running on NT platform with JAVA programming. The vacuum pressure, the magnet power supplies is read directly from the PLC and recorded ever 10 minutes.

Web server program is also run on this computer to deliver system status to the outside network. The whole control system is connected within a single private network. However, for security reason, the delivery of system information cannot be accessed directly to this computer.

As shown in Fig. 2, an extra web server is installed to deliver information to the outside network. The communication between ACQ-SRV and web server can only be done via the router, which will act as a firewall. Only packets from this web server will be allowed to access ACQ-SRV and also HTTP (port 80) request will be responded to. Additionally, the communication is only restricted to a one-way request by web server to ACQ-SRV only. This will further increase the security of internal network. The status information is delivered to the client in the form of XML data. This implementation is realized to be more convenience than delivering plain text or HTML information to the client as more data is begin requested by client everyday.

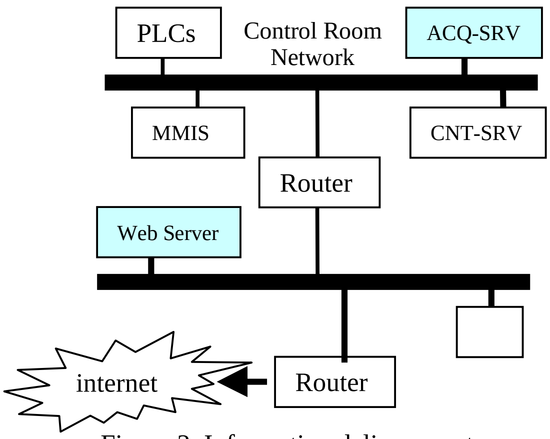

Figure 2. Information delivery system

The client makes a request to the web server using Java Script and XMLHTTP Active-X object. This way faster refresh of information can be made because only part of the web page needed be update with new information. When web server receives the request from the client it will execute a script to further obtain information on ACQ-SRV by XMLHTTP ActiveX object. Machine status information supplied by ACQ-SRV is gather by a specially written program that frequently scan the PLC for specific data and written onto the ACQ-SRV.

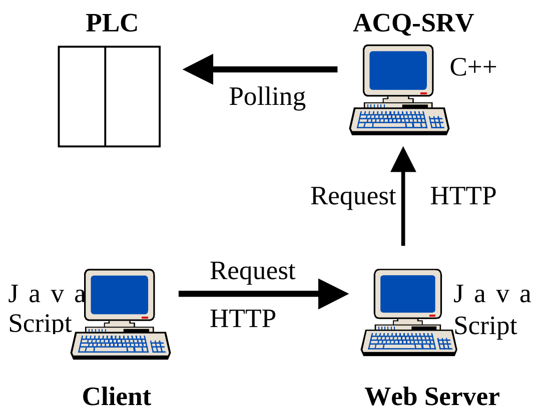

Figure 3. Information Request Cycle

Graphical display on client's computer is also generated on the fly. This technique can be useful to dynamically generate graphical information to match individual demand. This can be achieved without system performance degradation because all of the work load is now given to the web server not the ACQ-SRV.

4 CONCLUSION

The commissioning of the Siam Photon accelerator complex is underway. The newly built control system has shown a high reliability for controlling complex systems with ordinary PC. The integration of old control hardware with various interfacing requirements with modern digital system has demonstrated a successful task. New advance technique in computer technology is also help to deliver fast and secured information with a lesser effort.

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