Device Control System for the Two-arm Spectrometer System

T. Wakasa,[a] Y. Sakemi,[a] M. Uraki,[a] K. Nagayama,[a] and K. Hatanaka[a]

[a] *Research Center for Nuclear Physics (RCNP), Ibaraki, Osaka 567-0047, Japan*

The new control system was designed and built for the operation of the WS beam line [1], as well as the two-arm spectrometers, Grand Raiden [2] and Large Acceptance Spectrometer [3]. The WS beam line can satisfy not only the lateral and angular dispersion matching conditions with Grand Raiden in dispersive mode, but can also operate in achromatic mode.

A slit system in the horizontal direction is installed in the WS beam line in order to be able to restrict the momentum spread of the beam. There are two additional slit systems at the double focus point in achromatic mode. They are used to eliminate beam halo components. This is essential to obtain clean spectra with the Grand Raiden spectrometer at forward angles [4]. An active slit system with plastic scintillators mounted on slits has been used to monitor the spatial beam distribution at the end of the last section of the beam line. These slit systems in the beam line should be controlled remotely in order to provide quickly good quality beam suitable for each experimental requirement.

All the movable devices are operated with either a stepping, Alternating Current (AC), or Direct Current (DC) motor [5]. The stepping motors are driven by drive units. Two types of pulses are used for the clockwise (CW) and counter-clockwise (CCW) rotations. The AC and DC motors are operated with 100V-AC and 12V-DC, and they can also rotate in both CW and CCW directions. The drive units for the stepping motors and the power supplies for the AC/DC motors are installed in the experimental room. Thus a control unit had to be developed, which can not only generate CW and CCW pulses for the stepping motors but which also can switch on and off AC/DC power supplies for operating the AC/DC motors. Furthermore this control unit needed to be remotely controlled because it is installed in the experimental room which is far from the control room and also not accessible during experiments.

The motor control units are built with the Yokogawa FA-M3 controller [6] which is one of the commercially available Programmable Logic Controllers (PLC) (See Fig. 1). Two control units are used, one for the devices in the WS beam line and Grand Raiden and another one for the devices in the Large Acceptance Spectrometer. Each device has a stepping/AC/DC motor, a potentiometer for monitoring the position of the device, and two limit switches for CW and CCW rotations. The stepping and AC/DC motors are driven by the positioning modules and the relay modules connected to the AC/DC power supplies, respectively. The potentiometers are connected to the A/D modules, and the status of the limit switches is detected with the input/output (I/O) modules. All modules are controlled with a CPU via a special high-speed bus. The remote access to the CPU is accomplished by an Ethernet module.

A personal computer (PC) serves as a host computer running a free-Unix clone of Linux. It communicates with the CPU via the Ethernet module. The host computer and Ethernet module (control unit for motors) are connected to our local area network (LAN). Dynamically loadable modules for Tcl [7] were developed to allow access to the CPU of the control unit by means of the TCP/IP socket communication so that the control program can be written solely in TCL script.

Figure 2 shows the Graphical User Interface (GUI) for controlling the movable devices.

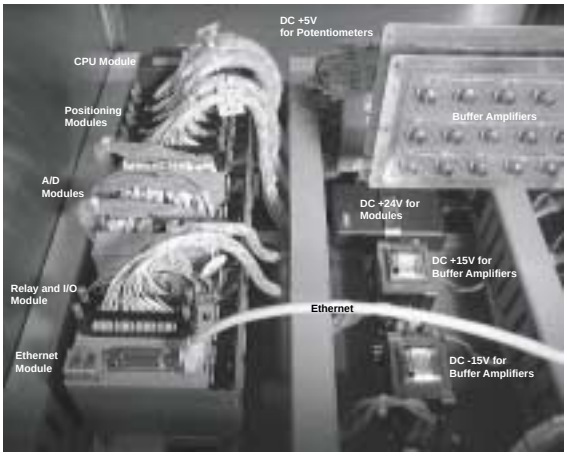

Figure 1: An assembled control unit for motors with Yokogawa FA-M3 controller modules.

Figure 2: A view of the GUI for the movable devices.

The input of the control system for each device is the preset value of its potentiometer, and it is distributed to the corresponding sequence CPU module. All distributed data are recorded in data registers. The programs continuously check these data and compare them with the corresponding actual values of potentiometers. If the preset and actual values differ more than a given value, the corresponding motor is driven to the appropriate direction. The programs also monitor the status of the limit switches. If a limit switch is active, the program terminates driving the corresponding motor.

References

[1] T. Wakasa *et al.*, Nucl. Instrum. Methods Phys. Res. A **482**, 79 (2002).
[2] M. Fujiwara *et al.*, Nucl. Instrum. Methods Phys. Res. A **422**, 484 (1999).
[3] N. Matsuoka, T. Noro, K. Tamura, M. Yoshimura, M. Yosoi, A. Okihana, and T. Yoshimura, Phys. Lett. B **359**, 39 (1995).
[4] M. Itoh *et al.*, Nucl. Phys. **A687**, 52c (2001).
[5] VEXTA Series, Oriental Motor Corporation, Taito, Tokyo 110-0005, Japan; http://www.orientalmotor.co.jp/.
[6] FA-M3 Range-Free Multi Controller, Yokogawa Electric Corporation, Musashino, Tokyo 180-8750, Japan; http://www.yokogawa.co.jp/ia/fam3.htm.
[7] J. K. Outerhout, Tcl and the Tk Toolkit (available at URL http://www.scriptics.com).