Embedded EPICS Controller for KEK Linac Screen Monitor System

M. Satoh, K Mikawa, F. Miyahara, T. Suwada, and K. Furukawa
Accelerator Laboratory, KEK, 1-1 Oho, Tsukuba, Ibaraki 305-0801, Japan
T. Kudou and S. Kusano
Mitsubishi Electric System & Service Co., Ltd, 2-8-8 Umezono, Tsukuba, Ibaraki 305-0045, Japan

Abstract

•The screen monitor (SC) of the KEK linac is a beam diagnostics device to measure transverse beam profiles with a fluorescent screen. The screen material is made of 99.5% Al2O3 and 0.5% CrO3, with which a sufficient amount of fluorescent light can be obtained when electron and positron beams impinge on the screen. By detecting the fluorescent light with a charge-coupled device (CCD) embedded camera, the transverse spatial profiles of the beam can be easily measured. Compact SCs were previously developed in 1995 for the KEKB project. About 110 compact SCs were installed into the beam line at that time. VME-based computer control system was also developed in order to perform fast and stable control of the SC system. However, the previous system becomes obsolete and hard to maintain. Recently, a new screen monitor control system for the KEK electron/positron injector linac has been developed and fully installed. The new system is an embedded EPICS IOC based on the Linux/PLC. In this paper, we present the new screen monitor control system in detail.

System Overview

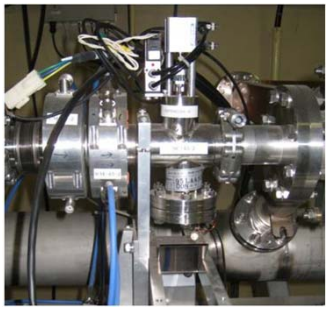

FIG. 1: Typical screen monitor installed in the beam line at the KEKB injector linac.

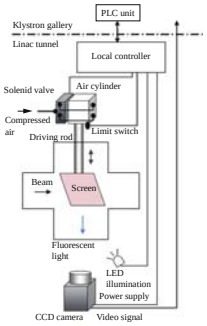

FIG. 2: Block diagram of the screen monitor system.

• Compact SCs were previously developed in 1995 for the KEKB project. About 110 compact SCs were installed into the beam line at that time as shown in FIGs, 1 and 2 [1, 2].

• The compactness of the monitor along with the fast control system made it possible to decrease the driving time of the monitor (~ 0.2 s) from its home position to the center of the beam line.

• The screen actuator comprises a driving rod, an air cylinder driven by compressed air through a solenoid valve. The screen actuator controls the screen motion into the center of the beam line. Fluorescent light emitted from the screen through a glass viewport is guided down to a floor level by optical mirrors, and the fluorescent light is detected by a CCD camera.

• The video signals of the camera are sent to a monitor control station at the klystron gallery, where a video-signal selector selects a particular channel corresponding to the required SC by following an implementation of the control system. Then, the selected video signal is sent to the main control room through optical-fiber cables after converting the electrical signal to an optical signal by an electro-optic converter (E/O module). The beam-profile image can be monitored by a TV monitor.

New System

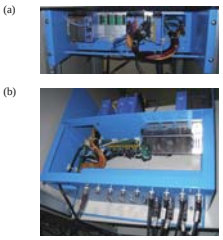

FIG. 3: PLC-based screen-monitor control system, (a) front view and (b) rear view.

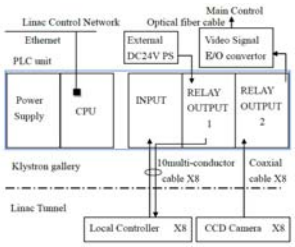

FIG. 4: Block diagram of the PLC-based screen-monitor control system.

• Linux-based PLC [3] (FIG. 3)

• The basic functions:

a) actuator control (up and down)

b) selecting the specified video signal

• When the server receives a control request from an operator interface (OPI) through the linac control, it selects a channel of a digital relay output (DO) module corresponding to the specified screen, and then the DO implements the actuator control (FIG. 4).

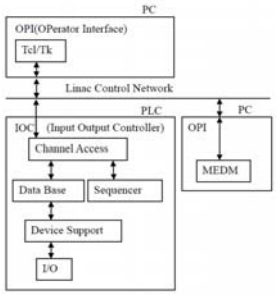

FIG. 5:Flow chart of the control software in the PLC.

• The limit switch signal of the actuator positions is fed into a digital input (DI) module. The DO module is also used as a video-signal selector in which a video signal outputs from 8 input channels. The software of the new control system has been developed in EPICS and Linux-based environment [4]. The flow chart of the control software is shown in FIG. 5.

• EPICS IOC on the PLC selects a specified I/O channel through a device support corresponding to the specified SC according to a database.

• OPI has been also developed in Linux environment on the PC. The main OPI program was developed by using Tcl/Tk scripting language.

Summary

•Toward SuperKEKB project, a new SC monitor control system using Linux-based PLC was developed and installed.

• Twelve four controllers in total have been finally replaced in Summer 2011 instead of the old VME-based ones.

•Now, whole the new SC system has been well working without any fatal troubles, and it is made full use of the linac stable operation.

References

[1] T.Suwada, A.Enomoto, T.Urano, and H.Kobayashi, Proceedings of the 20th Linear Accelerator Meeting in Japan, Osaka, Japan, 1995, pp. 245-247.

[2] T.Suwada, N.Kamikubota, K.Furukawa, and H.Kobayashi, Proceedings of the 22th Linear Accelerator Meeting in Japan, Sendai, Japan, 1997, pp. 329-331.

[3] http://www.yokogawa.com/.

[4] EPICS home page, http://www.aps.anl.gov/epics/.