Improvements for

Simple Operation

at SAGA-LS Accelerator

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The SAGA Light Source (SAGA-LS) is a medium-size synchrotron light research facility located at Kyusyu-Island, Japan [1], [2], which consists of 255 MeV linac and 1.4 GeV electron storage ring. The control system of SAGA Light Source has been developed in the early phase of the machine commissioning in-house efforts using PC-LabVIEW. Commercial off-the-shelf Input output (I/O) devices such as PLC (Yokogawa: FA-M3), distributed I/O devices (National Instruments: Fieldpoint) with MS-Windows PC server work as PC Input Output Controller (PC-IOC). ActiveX CA [3] is used for communication protocol between the server PCs and client PCs. Although the control system is stable, the increase of number of client PC makes the daily operation complex. Thus we develop the multi-purpose client program, which is running on MS-Window 7 with touch panel display. Furthermore, we have constructed the communication interface between accelerator control system to radiation interlock system to set the interlock mode from the accelerator control system. By this multi-purpose client program and the interfaces to the interlock system, the procedures of daily accelerator operation have been significantly simplified.



We selected commercial off-the-shelf distributed input output devices such as PLC and Fieldpoint with PC server as PC-IOC. To communicate with server PCs and Client PCs, the ActiveX CA is used. Though the PC-based accelerator works stable, the increase of the number of client PC makes the daily operation complex and sometimes causes human errors. Thus we have newly constructed the <u>multi-</u> purpose client application program which automatically process the operation procedure as injection scheme.



Sigils Control System



PC server with Commercial base off-the-shelf Input output (I/O) devices such as PLC (Yokogawa: FA-M3), distributed I/O devices (National Instruments: Fieldpoint) work as Input Output Controller (IOC). ActiveX CA which emulate EPICS Cannel Access is used for communication protocol between the server PCs and client PCs.



erOperation	Limit & Interlock	GUN	Linac KLY	Permission	Ring Mags	Sep & Kicker	COD Correction	Undulators			
Hor	izontal offset file name 100407オフセット X Beam Position (mm) meanH standard deviation -0.021 0.123	R-Matrix-file n h.txt I 070618-D-140 nH afterH mean afterH star -0.039 0.189	ame H DOMeV-1AXX Indard deviation UserOperation	Vertical Y Bean meanV 0.011 2.0- Limit & Interlock	n Position (mm) standard deviationV afterV me 0.059 -0.057 GUN	R-Matrix-file name 070618-D-1400MeV-1AYY ean afterV standard deviation 0.272 Linac KLY	Permission	Ring Mags	Sep & Kicker	COD Correction	Undulators
	-1.0- -2.0- 0 1 2 3 4 5 toleranceH errorH 2 \$0.050 0	rms value max value 5.881 15.117 8	SAGA-LS A		Introl Stored Curren 297.21 inac_Beam_OFF_Sequence	Stored Current Ring Energy Ring Life Vertical Beam Size Linac Curr 297.21 mA 1.400 GeV 10.6 h 61.5 µm CM1 0.00 geam_OFF_Sequence Storage RingInjecton User_Operation_Permission LS3U Full O OK OK ON N Gap 80.000		Linac Current CM1 CM2 0.00 nA 0.00 LS3U Full Open LS4U Full LS3U Permission LS4U Per Gap Upper Phas 80,000 mm 0.000	Irrent CM2 CM3 CM5 nA 0.00 nA 0.00 nA II Open LS4U Full Open Image: CMS manual state		
御器	BPM 00000 SFx 00000 SDx 00000 STx 00000		 Injection_Ma Beam Switch Master_Trig KLY1 SOFT S KLY2 SOFT S GUN GATE V SEPTUM&KIA RF_KO ON 	ode_ON n ON ger_ON tTART tTART ALVE OPEN CKER ON	 GRID TRIGGER OFF GUN GATE VALVE CLOSE KLY1 SOFT STOP KLY2 SOFT STOP SEPTUM&KICKER OFF RF_KO OFF 	RampUp OK RampUp_Fini COD SET OK?	Skew Cont 0.35 • RampUp • Ring PS • Ring PS	rol 32 30 27 25 Mode Set 22 Manual Control 20 FeedBack Control 17	5- 0- 5- 0- 5- 5- 0- 5-		
			GRID TRIGO ON ON SEPTUM&KICK POWER	ER Limit	GRID TRIGGER OFF OFF GUN REMOTE-COMPUTER KLY1 ETHERNET KLY2 ETHERNET	ShutDown Interloci Abor	 LS3U Dip LS3U Qu LS3U Sk LS4U Dip LS4U Dip LS4U Qu t LS4U Sk 	ad Correction 12 ad Correction 10 ew Correction 7 bole Correction 5 ad Correction 2 ew Correction 15	0		15:54:57

Multi-purpose CA-client works as the total station of many client programs (switched using tab key), and sequentially process operation procedure as injection scheme and it automatically set the interlock mode. The application treats over 110 EPICS Process Variables (PVs).



hiection M ode Set/0 ff.

♦Beam Switch 0 n/0 ff

Acceleration of thestorage ring and Accumulation Mode Set/0 ff.

♦Perm ission for Acceleration of the storage ring.

♦Perm ission for experimentalusage.

A on itor the each status.

Signals are hardwired, not directly connected with the Ethernet LAN for secure communication.

CENTRESCOND INCLASS

Y'LELL'Y

At injection

•Injection Mode Set (Radiation and human interlock system) •Beam Switch ON (Radiation and human interlock system) •Master Trigger ON •Linac Klystron modulator ON (Linac Auto Preparation) •Grid pulser ON **G**UN) •RF-KO ON for filling pattern) •Adjust Septum strength

After the accumulation of 300mA current at 255MeV •RF-KO OFF •Master Trigger OFF •Linac Klystron modulator OFF •Request Acceleration (Radiation and human interlock system) •Ramping Up the Energy of Storage Ring

After the acceleration to 1.4 GeV

 \Rightarrow automatically processed •Magnet Tuning, Feedback, feed-forward ON •Global COD correction \Rightarrow automatically processed •Set the insertion device to the user mode position ,Put Permission Signal from the beam line. \Rightarrow automatically processed •Ring RF Voltage change from 500kV to 550kV \Rightarrow now developing •Adjust Vertical Beam Size 60µm) \Rightarrow if needed •Put Permission Signal for user operation \Rightarrow daily work

- \Rightarrow automatically processed
- \Rightarrow automatically processed
- \Rightarrow not on-lined
- \Rightarrow daily work \Rightarrow daily work
- \Rightarrow now developing
- \Rightarrow if needed
- \Rightarrow now developing \Rightarrow not on-lined \Rightarrow automatically processed
- \Rightarrow automatically processed

We have constructed <u>multi-purpose client program</u> and <u>interface</u> between accelerator and radiation interlock system.

The transformation to the original CA client to the multi-purpose CA client program was straightforward, since from the beginning of the construction of CA client, the programs have been developed as multistand-stand CA client, which works simultaneously in different PC.

In the multi-purpose client program, many tasks for injection and accumulation are sequentially processed step by step. By developing this client application, the complexity of the daily operation has been significantly reduced. To adopt touch panel display with MS-Windows 7 allows the intuitive operation.

As for the future plan we are intending "One-touch" operation of the SAGA-LS accelerator.

[1] T. Tomimasu, et al., "The SAGA Synchrotron Light Source in 2003", p. 902 (2003). [2] Y. Iwasaki, et al., "Lattice Design of SAGA Synchrotron Light Source", p. 3270 (2003). [3] Kay-Uwe Kasemir, (2003), http://ics-web.sns.ornl.gov/kasemir/axca/index.html.