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INTERGRATED MULTI-PURPOSE TOOL FOR DATA PROCESSING AND ANALYSIS VIA EPICS PV ACCESS*

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Abstract

At the KOMAC, we have been operating a proton linac, consists of an ion source, low energy beam transport, a radio frequency quadrupole and eleven drift tube linacs for 100 MeV. The beam that users require is transported to the five target rooms using linac control system based on EPICS [1] framework. In order to offering stable beam condition, it is important to figure out characteristic of a 100 MeV proton linac. Then the beam diagnosis systems such as beam current monitoring system, beam phase monitoring system and beam position monitoring system are installed on linac. All the data from diagnosis systems are monitored using control system studio for user interface and are archived through archiver appliance [2]. Operators analyze data after experiment for linac characteristic or some events are happened. So data scanning and processing tools are required to manage and analysis the linac more efficiently. In this paper, we describe implementation for the integrated data processing and analysis tools based on data access.

INTRODUCTION

We have been implemented KOMAC control system based on Experimental Physics and Industrial Control System (EPICS) framework. Control System Studio (CSS) and archive appliance for data archiving that can communicate with EPICS using Channel Access protocol has adopted for managing data. Figure 1 shows the block diagram of KOMAC control system.

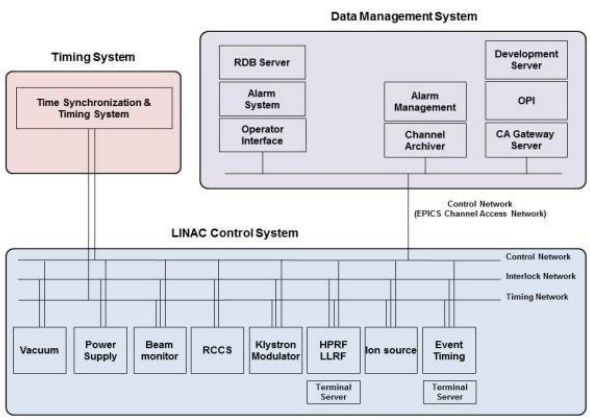

Figure 1: The block diagram of KOMAC control system.

The control system is divided into three types: LINAC control system for monitoring linac status; Timing system to synchronize all the devices; Data Management system for archiving and processing the acquired data. KOMAC has been managing five target rooms for users. To provide proper proton beams it is important to figure out linac characteristics. Therefor various beam diagnostic systems such as Beam Current Monitoring system, Beam Phase Monitoring System, Beam Position Monitoring system and wire scanners, are installed in beamlines and target rooms. And Data processing tools are required to analyse acquired data from beam diagnostic system. So High level applications have been developed to analyse the.

LEBT SCAN TOOL

Low Energy Beam Transport (LEBT) system consists of two solenoids magnets and two steering magnets for high current proton beam and minimization of beam losses, as LEBT system match the ion beam from ion source into the Radio Frequency Quadrupole (RFQ) as power supplies for LEBT system are controlled. To analyse and characterize LEBT system, magnet current need to be changed in various range. It takes a lot of time and effort to do it manually. Therefor we have been implemented LEBT SCAN tool based on CSS and Python [3] script, which can access EPICS Input Output Controller (IOC) using channel access libraries. Figure 2 shows LEBT scan tool.

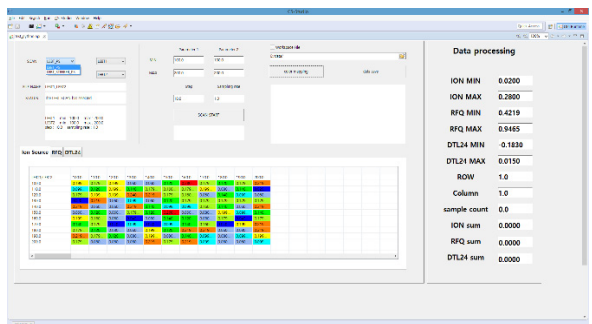

Figure 2: The LEBT scan tool.

The LEBT scan starts when the operators enter a proper value and click the start button. The acquired data that are ion source current, RFQ current, DTL24 current data from Beam current monitoring system, are shown progress table and all the raw data are archive in text format in the designated directory. When scanning is over, the result of LEBT scan is shown in table using color map.

PHASE SCAN TOOL

To increase the beam power, it is important to set proper set points of RF amplitude and phase. The RF phase is measured by 10 stripline-type BPMs. The beam energy is measured using the data from two BPMs. The Phase scan

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tool adjusts phase set of the RF and saves the measured data from 2 BPMs. The Phase scan tool shown in Fig. 3.

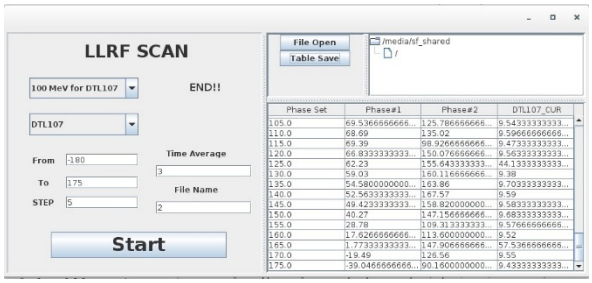

Figure 3: The Phase scan tool.

The result of the beam phase measurement is saved in text form and the beam energy are calculated through the Matlab-based user interface. Figure 4 shows the result of the phase scan.

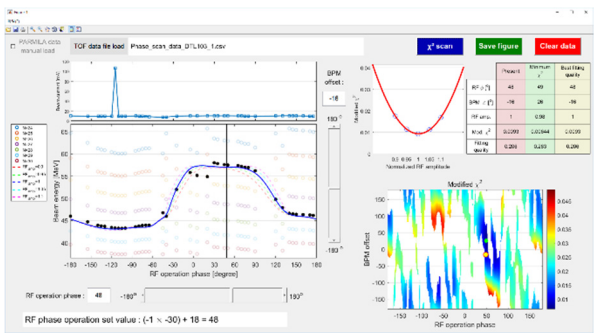

Figure 4: The result of the phase scan.

DATA BROWSER

The archive appliance was chosen as the KOMAC data archiving system and two archive appliances are used in a cluster. Figure 5 shows the architecture of the archiving system for KOMAC.

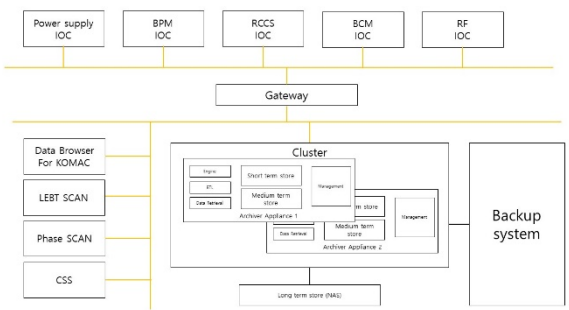

Figure 5: The architecture of the archiving system for KOMAC.

The stored data through the archive appliance can be loaded and extracted using CSS toolkit. To get the desired data operators need to extract the loaded data using CSS and then process the extracted data. To simplify the process a data browser has been implemented to load data into Python using JSON and then plot the loaded data using MATPLOTLIB [4] and TKINTER. Figure 6 shows the data browser.

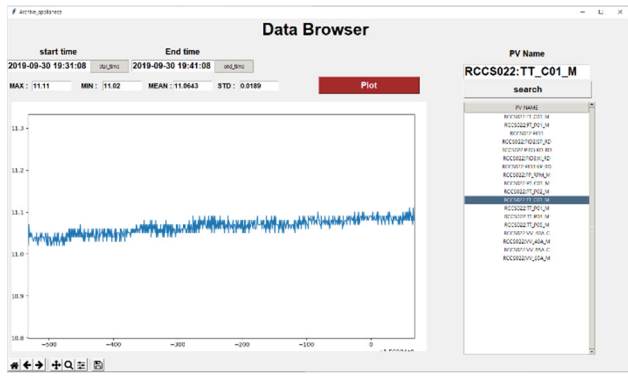

Figure 6: The data browser for KOMAC.

When inputting required data PV prefix and selecting search button, PV list with corresponding prefix among PVs, which are stored in archive appliance are shown in tree form. The data in the required time zone are plotting in graph form using plot button and the average, maximum, minimum and standard deviation of the output data are displayed above the graph. As selecting the interval on the graph using mouse click, the average maximum, minimum and standard deviation of the interval is recalculated and shown as Fig. 7.

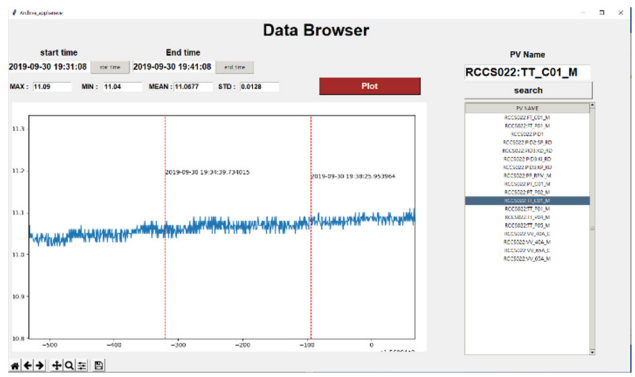

Figure 7: The result of setting interval for retrieved data.

If you press the plot button after selecting another PV, the previously drawn data disappears and the current PV is drawn.

The data browser can draw waveform and array data. The waveform data are stored using archive appliance and the stored data remain for a moth by archive policy In order to distinguish the array data from the others, the getPVTypeInfo() function is used to read the 'RTYP' field of the PV before retrieving the data. If the data type of PV is 'waveform', the data browser plots the only data at start time. Data processing of the interval also applies to waveform data. Figure 8 shows the plotted waveform data using data browser.

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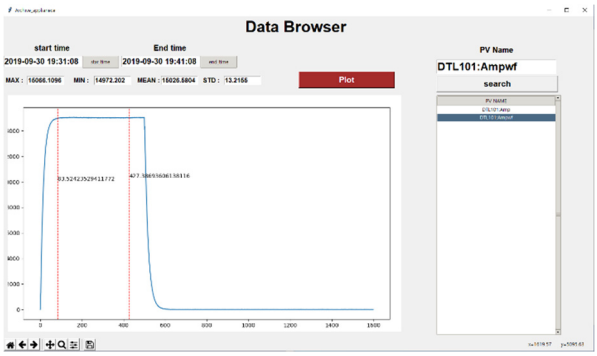

Figure 8: The result of the waveform data retrieval.

CONCLUSION

The Integrated Multi-Purpose Tool for Data Processing and Analysis via EPICS PV Access has been developed. The focus of the integrated tools is to provide convenience to users by simplifying the data processing process.

The LEBT scan tool changes the value of solenoid magnets current and steering magnets current and the result of scan are shown in color mapping table. The Phase scan tool adjusts the set of the RF and calculates beam energy and figure out the proper phase set point. The data browser retrieves the data, included waveform and array data, from archive appliance and plot the data. And by setting the interval on the plotted graph, the processed data are displayed.

In the future, selecting a specific time of the plot-ted data, the function to plot waveform data at that time will be added. And the tools for data processing and analysis will be integrated.

ACKNOWLEDGEMENTS

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[4] Matplotlib, https://matplotlib.org/