SNS* DIAGNOSTICS TOOLS FOR DATA ACQUISITION AND DISPLAY

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Abstract

The Spallation Neutron Source (SNS) accelerator systems will deliver a 1.0 GeV, 1.4 MW proton beam to a liquid mercury target for neutron scattering research. The accelerator complex consists of a 1.0 GeV linear accelerator, an accumulator ring and associated transport lines. The SNS diagnostics platform is mostly PC-based and runs Windows for its OS and LabVIEW as its programming language. The diagnostics platform as well as other control systems and operator consoles use the Channel Access (CA) protocol of the Experimental Physics and Industrial Control System (EPICS) to communicate. This paper describes the tools created to evaluate the diagnostic instrument using our standard programming environment, LabVIEW. The tools are based on the LabVIEW Channel Access library and can run on Windows, Linux, and Mac OS X. The data-acquisition tool uses drop and drag to select process variables organized by instrument, accelerator component, or beam parameters. The data can be viewed on-line and logged to disk for later use. A drag and drop display creation tool supports the quick creation of graphical displays to visualize the data produced by the instruments without the need for programming.

INTRODUCTION

The Beam Diagnostics group at SNS, ORNL is responsible for installing variety of instruments to ensure the reliability of the accelerator. To perform reliability tests, there is a need for tools that are user friendly, robust and also help to perform analysis without the need for programming. To cater such needs Data-acquisition and display tools are being developed with LabVIEW and CA protocol libraries. This combination is useful in creating user friendly design and to communicate with EPICS. These data acquisition tools can be used for viewing and logging the values of Process Variables (PVs) based on specified conditions. The primary goal of these tools is short term data storage to perform analysis for a particular set of instruments using LabVIEW. Since LabVIEW is our standard programming language the passage of data between various applications (built in LabVIEW) becomes simple. The design and working of such Data acquisition and display tools is discussed in following sections. The two main stages for these tools are data collection and data storage.

The list of PV names categorised by instrument, accelerator component or beam parameters can be put in a Tree format which would help the user to locate and select one or set of PV names. The selection can be done by just dragging and dropping the PV names to appropriate sections. These PVs can either be used as *PV-Monitors* or *PV-Scanned*.

The values of PV-Monitors and PV-Scanned can be obtained using CA monitors, CA synchronous get techniques provided by CA libraries [1] and this constitutes the Data collection stage. Once these values satisfy specified conditions they can be stored on to local disk or on a database over the network for further analysis. Figure 1 gives the graphical representation and general overview of the tool.
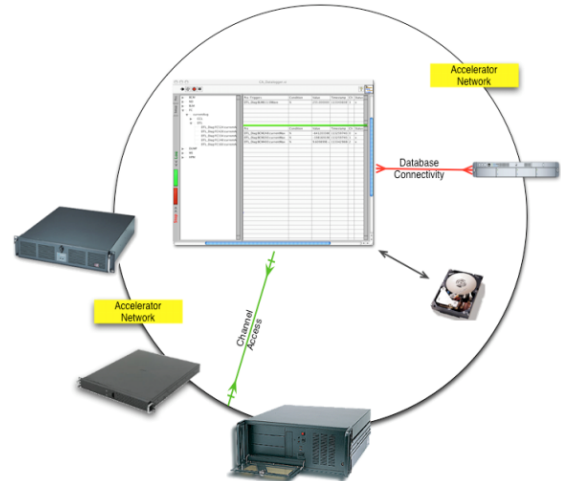

Figure 1: Basic overview.

With multiplatform capabilities of LabVIEW and CA interface, the user would require minimum or no effort for the initial deployment, once deployed there would be no difference in the usage of the tools across platforms. The program flow is shown in figure 2.
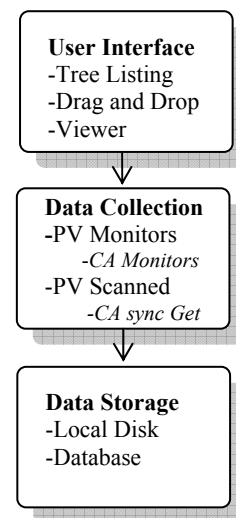

Figure 2: Program flow.

USER INTERFACE

LabVIEW provides advanced industry standard tools to create user friendly interface. An example of such user interface is shown in figure 3.
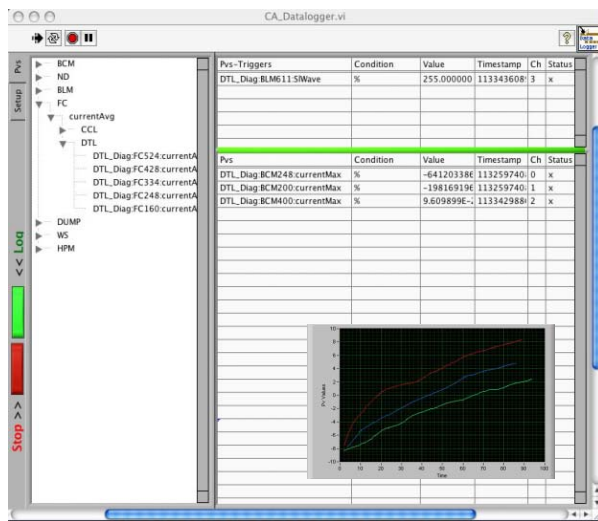

Figure 3: User Interface.

Tree Listing

Tree listing is a very useful technique when a large number of PV names are to be displayed with relevance. The categorisation can be dynamically achieved as the diagnostics PV names are structured. The user can navigate a tree and locate a required PV easily. The tool can give flexibility of selecting a category to add the set of PV names associated with it. A drag and drop feature can be used to put PV names to the view area where values are displayed and updated continuously. PV names listed in tree structure can be obtained from a configuration file which can be updated easily to accommodate more PV names.

Viewer

The PV values can be viewed using a viewer based on LabVIEW charts and waveforms which would give a nice time line representation of the data.

DATA COLLECTION

Data collection involves in selecting the PVs for online viewing or data logging. Figure 2 shows the user interface.

PV-Monitors

The values of the PVs dropped in monitor section can be obtained using CA monitors. The user can select one or set of PVs to be triggers. When more than one monitor is selected the tool shall wait until the entire Monitor PV values are updated.

PV-Scanned

The PV values that need to be logged or viewed can be dropped in to the section. PV values are updated using CA synchronous get functions when PV-Monitors are updated.

Conditional Triggers

Conditional Triggers are special conditions that can be used to narrow the range of values that need to be logged or viewed. This provides the user with one more dimension to eliminate certain value ranges that do not contribute to the current analysis.

DATA STORAGE

The second major stage of these tools is temporary Data storage. The data collected during the first stage can either be stored in local disk or can be placed in a database located over the network.

Local Disk

Data stored in local disk can be stored as text files for easy use with other analytical programs. A tab or comma separated values can be maintained for normal data. Waveform data can be stored in LabVIEW specific format to be used by analytical program written in LabVIEW.

Database Integration

Data can also be stored in temporary database by taking advantage of LabVIEW database connectivity tools. These data can be used for both online and offline analysis. Since the data stored in a database is structured other analytical soft wares can use standard SQL quires to access the data.

IMPLEMENTATION

A data acquisition and display tool shown in figure 3 was developed on windows platform to demonstrate the techniques mentioned in this paper. This tool was used in a small study conducted by diagnostics group to check the performance of Beam Loss monitors and Neutron detectors.

CONCLUSION

Creating such data acquisition and display tools is a work in progress, at present these tool have greater scope with in the Diagnostics group. The versatility of LabVIEW gives flexibility to tailor the applications to specific needs. These tools can easily be a part of supervisory software [2]. Adding web capabilities can also be considered.

REFERENCES

[1] A. Liyu et. al., "LabVIEW Library to EPICS Channel Access," This conference.

[2] W. Blokland, D. Murphy, D. Purcell, C. Long, M. Sundaram., "Dynamic visualization of SNS diagnostics summary report and system status", This conference.