Integrating LWDAQ into the Detector Control Systems of the LHC Experiments at CERN

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Introduction

The LWDAQ (Long-Wire Data Acquisition) software and hardware from Brandeis University, Mass., USA provides access to a powerful suite of measurement instruments. Two high precision monitors used to measure the relative alignment between a source and a sensor are included. The BCAM (Brandeis CCD Angle Monitor) cameras take images of point light sources and the RASNIK (Red Alignment System of NIKhef) cameras take images of the NIKHEF developed RASNIK mask.

Both systems are used in the LHC experiments at CERN. In order to incorporate the alignment data from the LWDAQ system into the Detector Control System (DCS) of the LHC experiments a new software component of the Joint COntrols Project (JCOP) Framework was developed.

LWDAQ

The BCAM and RASNIK devices are controlled via the LWDAQ Driver hardware, which includes an Ethernet interface for controlling the data acquisition process and retrieving the image data from the cameras.

The Acquisifier is an existing LWDAQ software package that communicates with the driver via the Ethernet interface using a custom LWDAQ specified protocol. The Acquisifier can run as an interactive application or can be controlled remotely via TCP/IP. The Acquisifier can be scripted with a file to perform a sequence of acquisition steps on the connected hardware.

The JCOP Approach

JCOP is a collaboration between CERN and the LHC experiments. It focuses on identifying and providing common controls tools, solutions and recommendations that can be used by the controls developers of each experiment to build the DCS.

JCOP has chosen the software called PVSS, developed by the Austrian company ETM, as the SCADA system for the LHC experiments.

In addition to the functionality provided by PVSS, JCOP also develops additional functionality to extend and ease the use of PVSS in the CERN context. This additional functionality is distributed as part of the JCOP Framework, which consists of a series of components that can be used and installed, as required, by the controls developers in the LHC experiments. The LWDAQ integration is just one example of these components.

"fwLwdaq" - the JCOP component for LWDAQ

The component provides the following features:

- A PVSS model of each LWDAQ device type. This enables a controls developer to model the exact LWDAQ hardware setup in the DCS.
- Automatic generation of the script needed by the Acquisifier to define the acquisition sequence to be used to measure the alignments.
- Control and monitoring of the status of the acquisition process.
- Support for archiving and alarm handling on alignment data.

The communication between the Acquisifier and DCS is achieved with a script written in the PVSS CONTROL language. This script opens a TCP/IP socket to communicate with the Acquisifier software. Once communication is established, the following commands can be sent to the Acquisifier:

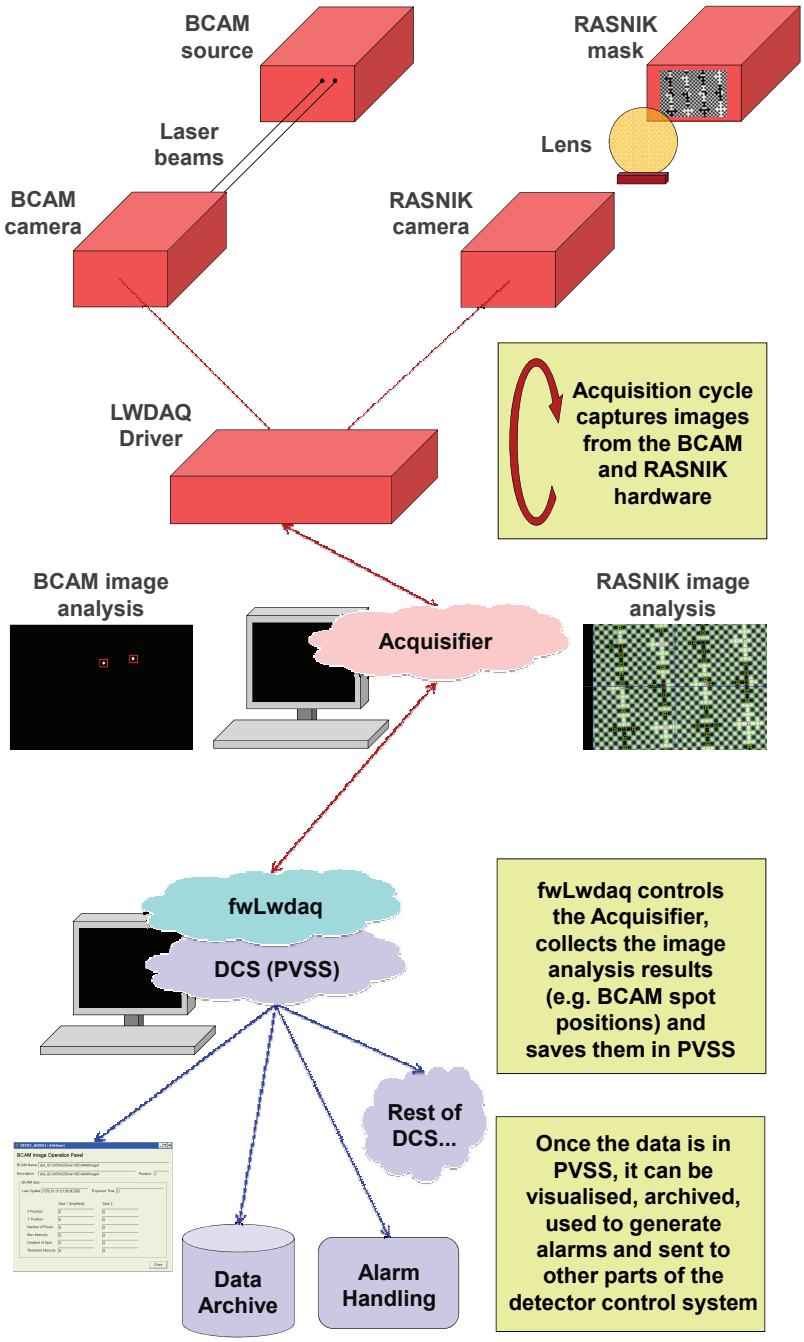
- Configuration messages for initial setup of Acquisifier.
- Start or stop of the acquisition process, including the option to run the acquisition script once only, or repeatedly in a loop.
- Request for the status of the acquisition process.

The Acquisifier can reply with the following types of response:

- The results of a single image capture. This is in the format of a string containing numerical information obtained from the image analysis.
- The current status of the acquisition process.

In order to allow the CONTROL script to distinguish the two possible responses, all image analysis data is given a defined prefix. Additionally, all results are configured to include the camera device name to uniquely identify the data so that it can be associated with the correct devices in the DCS.

The data returned for a BCAM image analysis includes the positions of the two spots using *x,y* coordinates. For RASNIK images the results include the *x* and *y* position of the mask, *x* and *y* axis magnifications and the mask rotation angle. This data can be archived for later analysis and can also trigger alarms in order to immediately draw the attention of DCS operators.



Conclusion

Using the features of PVSS and the JCOP Framework, a component supporting the LWDAQ system was made for the controls developers of the LHC experiments.

It was possible to reuse and benefit from the functionality of the Acquisifier software provided with the LWDAQ toolkit by using it as an interface between the PVSS CONTROL script and the LWDAQ driver.

The component provides a generic solution for BCAM and RASNIK devices. Controls developers have benefitted from this functionality, quickly implementing applications based on these devices. By distributing the work as a component of the JCOP Framework it has avoided the need for each DCS developer to implement a custom solution, thus avoiding duplication of effort.