

Summer Project Report

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August 16, 2010

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Introduction

Large modern experimental collaborations require the ability to monitor a large amount of scientific equipment and interpret a large amount of data. This report documents the progress made, over an eight week summer project, in investigating the use of EPICS (Experimental Physics and Industrial Control System) [5] with CSS (Control System Studios) [1] to control and monitor hardware with the view of using these two programs in the PANDA collaboration [2]. The use of ROOT [3] to analyse the data from EPICS in real time was also investigated.

EPICS

EPICS is a set of software tools, libraries and applications used to control scientific apparatus in real time over a computer network. First EPICS was installed on a computer and this computer linked to another, also with EPICS installed, over a network. In order to experiment with EPICS without using the actual hardware a softIoc was used. This imitates real hardware using a database file containing variables which have attributes such as a value and a description. These can be accessed and changed using EPICS commands in the same way in which a value can be measured and changed using experimental hardware.

The softIoc was started on one computer and EPICS commands used on another to access the database to read and write the data stored in the file. To access a value in an epics database, say temperature, the command “caget temperature” is used. (provided that the entry in the database is called temperature) Various attributes such as a description in the database entry can be accessed similarly using “caget temperature.DESC” for example. EPICS databases support a vast number of properties that can be assigned to an entry such as alarm ranges etc.

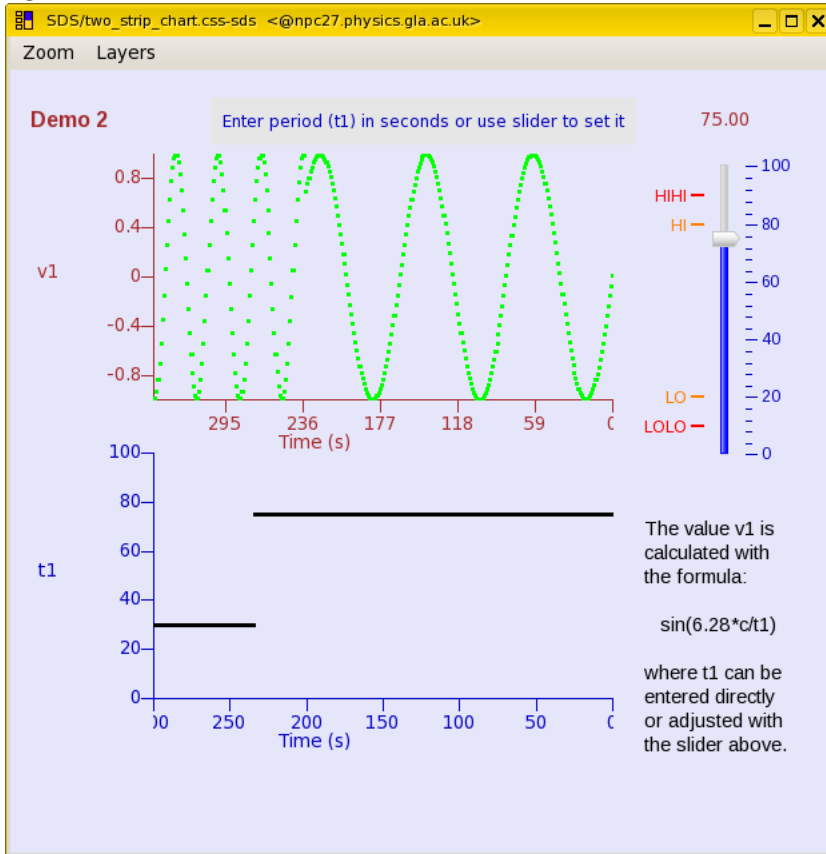
To write a value to an EPICS database again using the example of temperature we use the command “caput temperature”. Any computer connected to the network can put and get values from the EPICS database.

Control System Studios

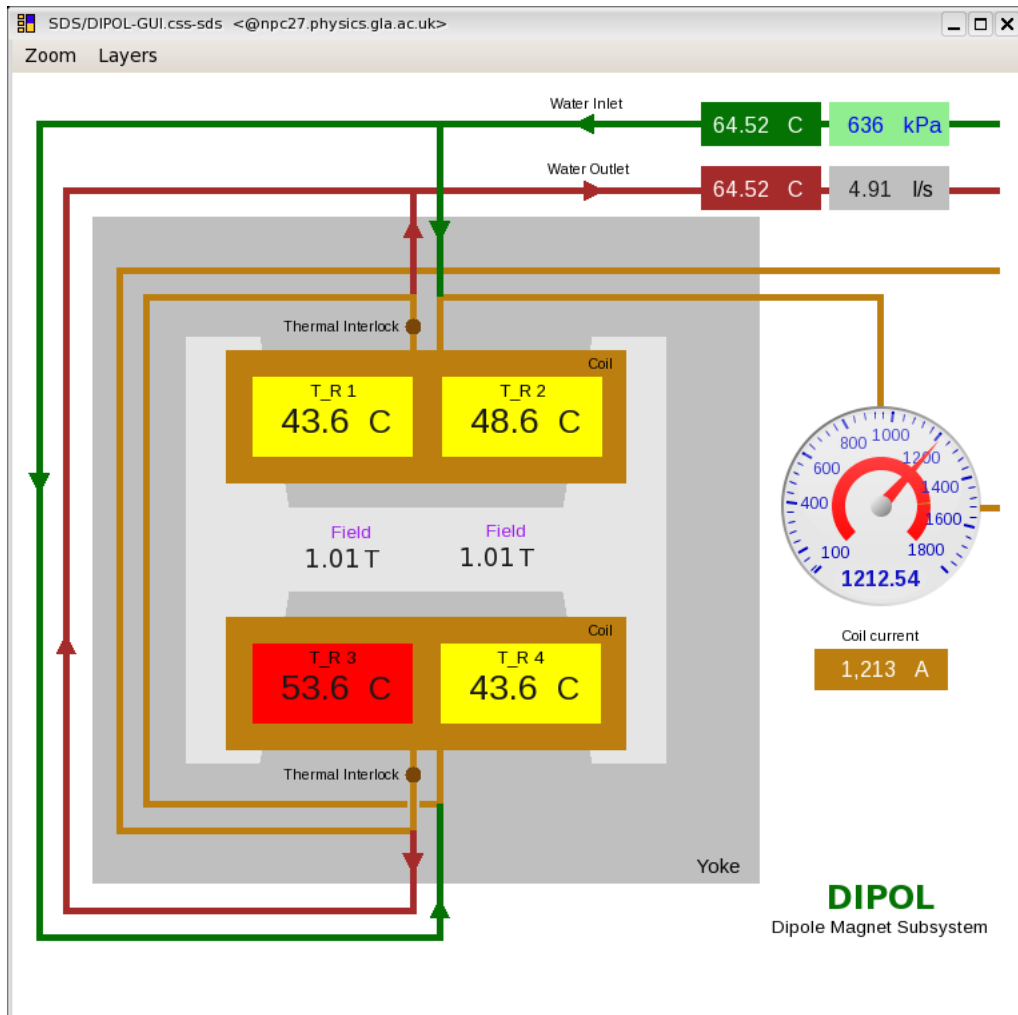
Control System Studios (CSS) is a software suite built on Eclipse (a Java development toolset) [4] that can be used to create GUIs for displaying the the controls of hardware in an experiment. CSS GUIs can be used in conjunction with EPICS to control an experimental setup.

CSS was installed on a computer and used to create some examples showing its uses in displaying data taken by hardware and for interacting with the hardware. A bash script was created to periodically change a variable stored in an epics database to create a sine curve. The period of the curve was dictated by another

epics database variable. CSS was used to graph both these variables against time and to control one of the variables so that the period of the sine curve could be changed from a CSS GUI as shown below.



A more complicated example to demonstrate the possible use of CSS in the PANDA collaboration was also created. This GUI could be used to control a dipole magnet which will be part of the hardware used in the PANDA collaboration. This example included warnings (in the form of a colour change) if the EPICS variables exceeded a certain range set in the EPICS database. A screenshot of this GUI is shown below



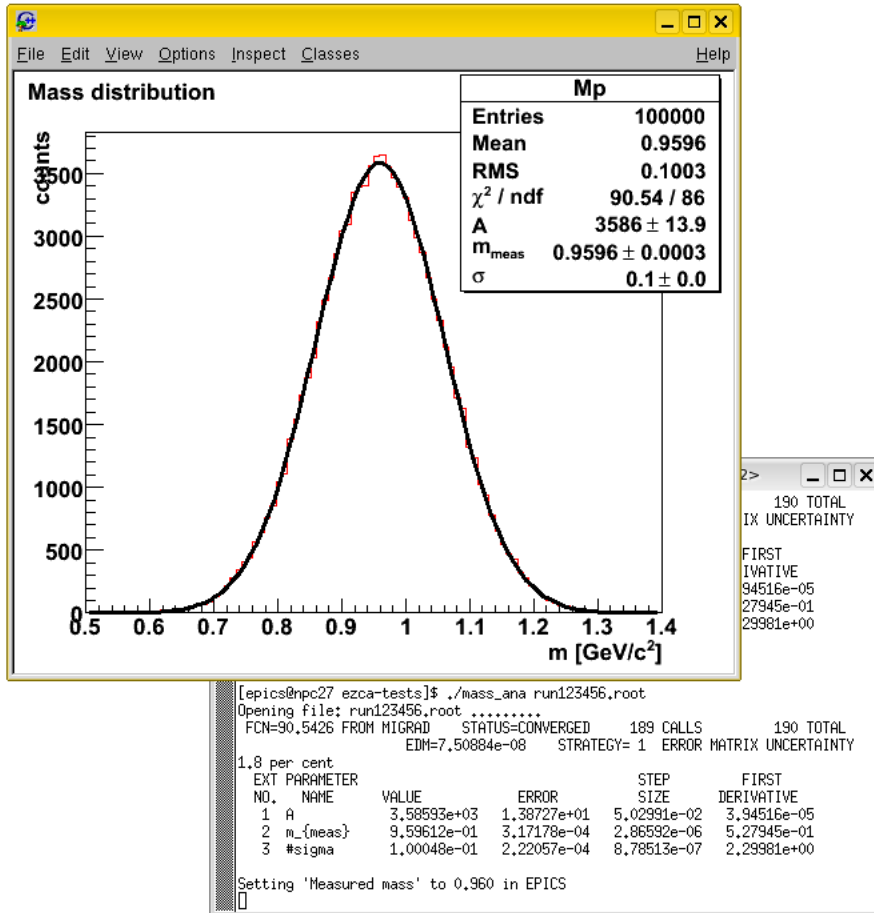
To configure the CSS objects to change colour under certain circumstances a script had to be written in Java and used to control the dynamic properties of the desired object in the CSS GUI. However there was a flaw discovered in the Java library used to define the colours that has yet to be resolved. The library would not accept certain RGB colour codes even though they were within the required range. It was also discovered that there is no way to start a CSS GUI without opening the full CSS environment first. However one of the CSS developers informed us that the next release of CSS will include such a function. It is also possible that the problem with the Java library will be fixed in the next release. If not this will require further examination before CSS is put into use in the PANDA collaboration.

ROOT with EPICS

ROOT is a data analysis program developed at CERN that can be used to plot and manipulate data in real time. In order to use it with EPICS a program called EZCA (Easy Channel Access) [6] had to be used. EZCA provides C++ commands that can be used to communicate with EPICS in a similar fashion as the “caget” and “caput” commands mentioned previously. However when these commands were used with the root compiler, CINT, an error was returned referencing one of the headers used by the commands. To work around this problem the Gnu C++ compiler, gcc, was used. This meant that the ROOT scripts would have to be compiled into a binary using the “Make” command and then executed as opposed to being run from the ROOT shell.

EZCA also supports the ability to detect errors in EPICS such as a network problem. Error reporting in EZCA is turned on by default however before an error is returned it will retry a large number of times. The number of retries can be set by the user if the default is too high.

As an example of the use of EPICS with ROOT a set of measurements of mass was loaded into ROOT, plotted on a histogram, the mean found and then put into an EPICS database.



This shows the potential for analysing EPICS data in real time to provide feedback in the PANDA collaboration.

Conclusion

In a large scale experiment CSS GUIs using EPICS to communicate with hardware provides an extremely useful and simplistic interface. Such GUIs are relatively simple to build and documentation to aid this process can be found on the wiki produced from this project at

<http://nuclear.gla.ac.uk/twiki/bin/view.pl/Main/EPICSGUIsInCSSSummerProject>.

To analyse the data produced from the experiment and provide feedback to the hardware ROOT is a very useful tool that can be configured to work with EPICS with relative ease. Documentation on this can also be found on the wiki.

References

- [1] desy. Css. http://css.desy.de/content/index_eng.html. [accessed 14 August 2010].
- [2] The Facility for Antiproton and Ion Research (FAIR). Panda. <http://www-panda.gsi.de/>. [accessed 14 August 2010].
- [3] The European Organisation for Nuclear Research (CERN). Root. <http://root.cern.ch/drupal/>. [accessed 14 August 2010].
- [4] The Eclipse Foundation. Eclipse. <http://www.eclipse.org/>. [accessed 14 August 2010].
- [5] Argonne National Laboratory. Epics. <http://www.aps.anl.gov/epics/>. [accessed 14 August 2010].
- [6] Argonne National Laboratory. Ezca. <http://www.aps.anl.gov/epics/extensions/ezca/index.php>. [accessed 14 August 2010].