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UPGRADE THE CONTROL SYSTEM OF HIRFL-CSR BASED-ON EPICS

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Abstract

Control system of HIRFL-CSR accelerator is now upgrading to new architecture based on Experimental Physics and Industrial Control System (EPICS). Design and implement power supply subsystem, data distribution subsystem, data acquisition subsystem, etc. This paper describes the design and implementation of the control system and introduce the next work for upgrading synchronization subsystem and middle/high level applications.

INTRODUCTION

The Cooler-Storage-Ring (CSR) is the post-acceleration system of the Heavy Ion Research Facility in Lanzhou (HIRFL) [1]. The HIRFL-CSR consists of two cooler-storage-ring, heavy ions will be accumulated and accelerated in main cooler-storage-ring (CSRm) and extracted to experimental ring (CSRe) or other target experiments [2]. The control system of HIRFL-CSR consists of many sub systems such as power supply control system, timing system, Low Level RF system, beam monitor system and so on. The structure of original HIRFL-CSR control system is shown in Figure 1.

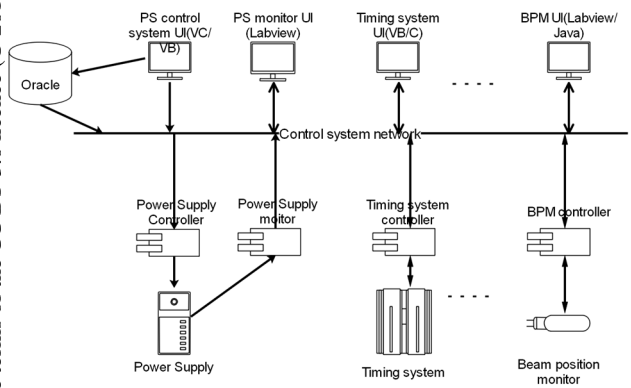

Figure 1: Structure of original HIRFL-CSR control system.

The original structure was not build on a uniform standard and created by different development tools. So, the different subsystem cannot communicate with each other, and very difficult to maintain. Also, developers who belong to different subsystems could not collaborate to build the whole control system.

EPICS is a set of Open Source software tools, libraries and applications developed collaboratively and used worldwide to create distributed soft real-time control systems for scientific instruments such as a particle accelerators, telescopes and other large scientific experiments [3]. EPICS defined a standard interface (Channel Access) for different subsystem and different hardware.

DESCRIPTIONS

This part wills description the structure of the new control system, also description a new modular development platform. Descriptions include two sections and each section is introduced in detail as following. The structure of the new control system is shown in Figure 2.

Structure of the New Control System

Upgrading the control system of HIRFL-CSR based-on EPICS since 2016. Redesign the whole structure of control system and implement kinds of Input Output Controllers (IOC) for the power supply subsystem, timing subsystem, database subsystem, beam monitor subsystem etc. Most of the IOC running on the CentOS at 1U industry PC via the Ethernet, serial port or PXIe interface. There is also small part of IOC running on the embedded Linux (FPGA SOC) and Windows.

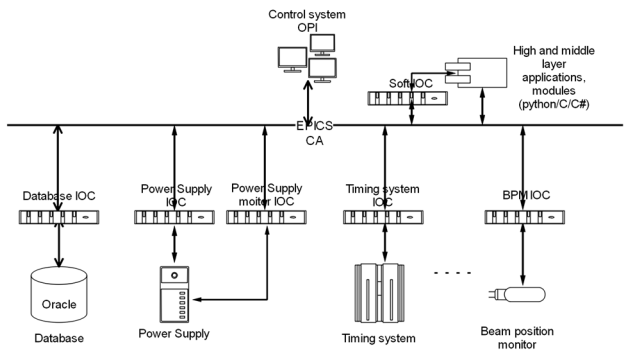

Figure 2: Structure of the new control system.

On the top level, use Control System Studio (CSS) [4] to implement Operator Interface (OPI) of the whole control system. The unified interface become more productivity and easier to use for the operator of accelerator. Figure 3 shows a screenshot of the OPI.

Up to now, there are over 1000 PVs running on the HIRFL-CSR (CSRm and CSRe). The main part of the new control system has been finished.

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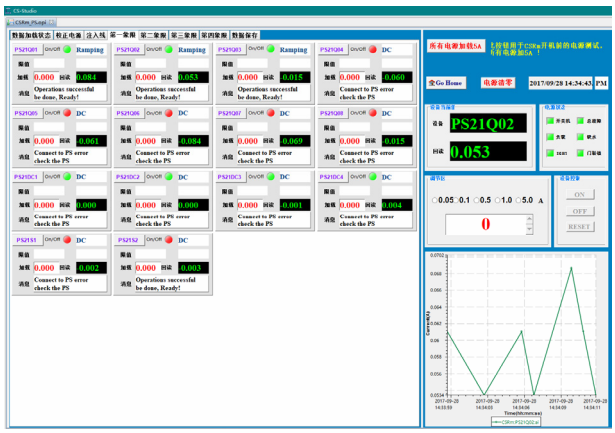

Figure 3: Screenshot of the new OPI

Design a new Modular Development Platform

After finished building hardware abstraction layer, the focus of the work moves to design high and middle layer applications, libraries and modules, such as closed orbit control tools, data process module for power-supply monitor etc. Designed a new modular development platform and to create high and middle layer applications under the platform. The simple structure of the platform shown in Figure 4.

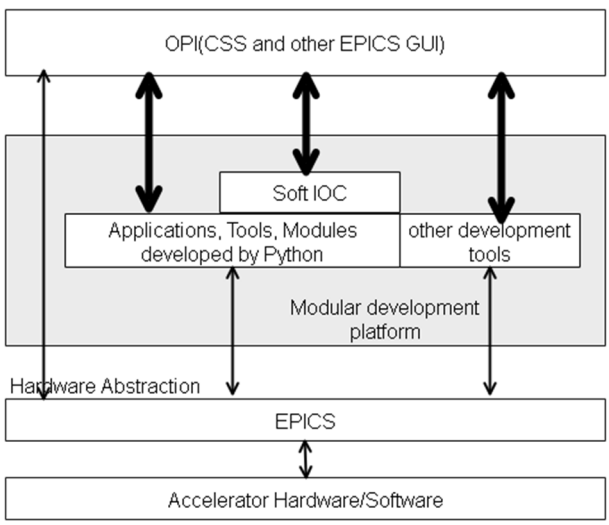

Figure 4: Structure of the platform.

First, use Python and other development tools to build the main modules for platform, now, have finished data source module (provide a common interface to access SQL and NoSQL database), OPI module (provide common UI interface which use CA), EPICS module (provide common interface to hardware abstract layer), etc. Developer who belong to different subsystem could collaborate to create high and middle layer tools, libraries and applications based-on the platform who don't need to know the detail of the accelerator hardware and low-level software.

Second step, have finished design and implement a ramping data calculate application for power supply (mainly targeted are dipole, quadrupoles, and LLRF) of HIRFL-CSR on the platform.

CONCLUSION

The main part of new control system has been tested and successfully running for more than one year. The stability of the new system is greatly improved. After finished building hardware abstraction layer, we plan to deploy the modular development platform with some finished tools and modules in this year.

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