IMPROVEMENT OF WEB-BASED MONITORING OF EPICS-IOC FOR PAL CONTROL SYSTEM*

J. M. Kim#, K. M. Ha, E. H. Lee, J. H. Kim and H. S. Kang,
PAL, POSTECH, Pohang, Kyeongbuk, 790-784, Korea

Abstract

We are now operating a web-based monitoring system of PAL control system with MAC Power PC. In order to expand the IOC's web-based monitoring system, we are trying to use the X86/Linux platform. With the experience which we got in developing the web-based monitoring of EPICS-IOC based on MAC Power PC, a web-based monitoring system with an X86 Intel PC based on a new concept has been developed for lower costs, easier access and use. Its operating system employs Linux Fedora Core4. In order to drive the web-based monitoring system, EPICS Base 3.14.8 and MySQL 4.0 have been installed in the Linux Fedora Core 4. Archive engine with C language and EPICS channel access library are programmed to store the data. As a result of using the web-based monitoring system based on the X86 Intel PC, we have achieved its easier access and use, more convenient maintenance. Performance of the web-based monitoring system with an X86 Intel PC will be discussed.

INTRODUCTION

These days, web-based monitoring systems are on gradual increase. Required for the application of such systems are rapid application of newly added sub-systems and feasibility of maintenance. Currently, PAL EPICS IOC web-based monitoring system use MAC power PC G4 CPU based Linux Fedora Core 4 installed in it. By the time it was first developed in 2002, porting Linux OS in Mac system was not easy, because installation of Linux OS in Mac PC requires modification and complementation of the kernel to suit G4 CPU. Usually, Linux OS is distributed for free, and the OS kernel is seldom modified to fit any particular platform for installation. The OS kernel modification requires so specialized expertise that establishment of one system costs a great deal of time, efforts, and money. For such reason, the EPICS IOC Web Server to be newly developed adopted Intel/X86 CPU, which is easily accessible and facilitates comparatively easy system build-up.

The development experienced in MAC power PC was of great help in designing and developing new systems. The strong point of Intel/X86 PC compared to the current system is the simplicity of configuring and its low cost for the system establishment. For the operating system, Linux Fedora Core 4 was installed to maintain the compatibility with the current system. Archive Engine functioned to read data from EPICS IOC and store them in database. IOC web sub-systems developed in the new hardware platform are Beam Current, LINAC BCM, Temperature, and Modulator.

*Work supported by …
#jmkim@postech.ac.kr

SYSTEM ARCHITECTURE

Figure 1 shows the architecture of PAL EPICS IOC web monitoring system. EPICS IOC(Input Output Controller) consists of 19 components, and IOC Web Server is composed of three units of MAC and one unit of Intel/X86 System. The network interface is separated into two layers, Office-net and Control-net. Since SR BPM and MPS system are located in Control network, the data communication needs to be done via separate gateway. Each of the IOC Web Server system basically stores beam current data, and they are displayed as reference when the user requests a data plot from monitor screen. Each of IOC data are classified and stored through four units of IOC Web Servers. The systems which provide web service directly to users are accessed only by way of beam current web server.

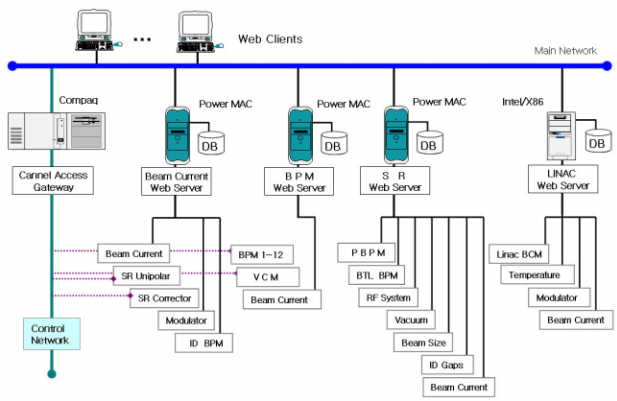

Figure 1: Architecture of IOC web monitoring system.

NEW HARDWARE SPECIFICATION

- CPU : Intel Pentium4 3.4GHz, Single.
- Memory : 2GB DDR PC400.
- Hard Disk : SATA 250GB x 2 Ea, 16MB Buffer.
- Chipset : Intel 865 + ICH5.
- Network Interface : 100Mbps.

INSTALL OF DEVELOPMENT TOOLS

In order to establish web based monitoring server, several software development tools have to be installed in advance. The tools installed are apache server for web service, EPICS 3.14.8 for channel accessing, MySQL Database for data storing, PHP Interpreter for web CGI programming, and gnuplot for tcl/tk and data plot. In

particular, cautions are needed when installing MySQL 4.0. InnoDB(Index) is installed as default from MySQL version 4.0, and this option needs to be taken out at Configure File while installing MySQL, since InnoDB requires a great deal of storage space. As PAL IOC PVs store data every three seconds or every ten seconds, disk storage space has to be spared as long as possible. And the reason why version 4.0 was chosen for MySQL is to keep the compatibility with the existing Mac system.

SOFTWARE STUCTURE

Figure 2 shows in a block diagram how data are processed in Web Server. As in the diagram, the PV data coming from all the IOCs are collected and first stored in MySQL database. Collecting the data from each IOC and storing them are operated by archive engine, which is created in C language by using EPICS channel access library. Archive engine collects raw data from IOC and periodically writes them in the applicable table of MySQL database every three seconds or ten seconds. In order to provide diverse data inquiry service to users, it is implemented using MySQL query instructions through PHP programming. Graphical display of data in the web client monitor is implemented with Gnuplot tool library.

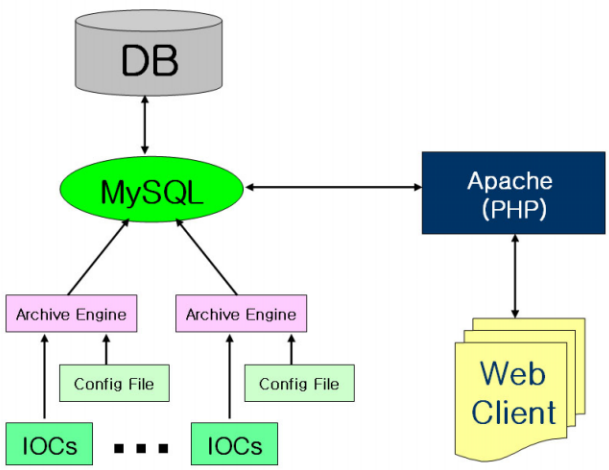

Figure 2 : Block diagram of Software Structure.

DATABASE DESIGNING

The purpose of PAL IOC web monitoring system database designing is to provide the service of rapid data inquiry in web client. To that end, one table is assigned to each PV of each IOC. That is done because web client can search out the temporary PV data stored in the database within 3 ~ 10 seconds through the assigned table. However, since such design involves too many simultaneously open tables, it has a shortcoming that too much computer memory resources are allocated. The reason the system is designed that way in spite of such weak points is for rapid data inquiry. This design lets the users temporarily store the current device value for all the IOC PV in a separate table(zPV), and display them real-time. And while the average values are calculated and stored every 30 minutes, they are named by attaching 'A' in front of the applicable PV table names. The inquiry times were greatly reduced by calculating and storing the values in separate tables when storing the average values. Figure 3 shows the PAL IOC Web Monitoring System homepage.

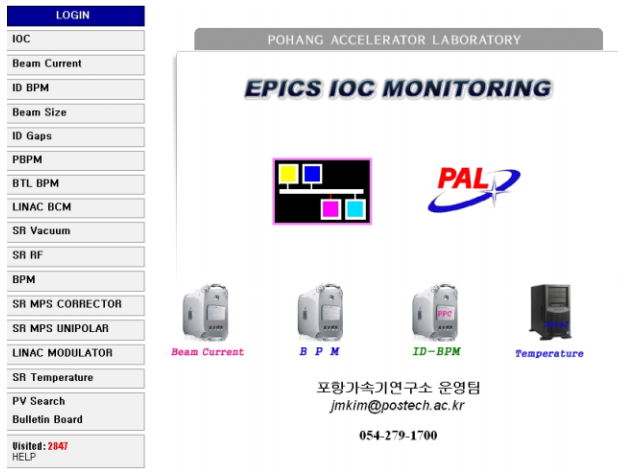

Figure 3 : PAL IOC Web Server Homepage.

STRUCTURE OF ARCHIVE ENGINE

Main Function
  MAIN:main()
  Engine:Begin()
   A. create Archive for MySQL
   B. ca_task_initialize()
   C. ca_create_channel(pvArray,myChid)
   D. Infinite loop (while)
      a. ca_element_count(myChid)
      b. pTD=malloc (nBytes)
      c. ca_get(DOUBLE,myChid,pTD)
      d. ca_pend_io(5.0)
      e. call WriteFunction()
      f. epicsThreadSleep(WaitTime)
   E. Infinite loop (end)
MAIN:end()

WriteFunction:run()
  a. CreateTableName()
  b. ChannelInfo(archive, channel)
  c. ArchiveMySQL(InsertPvValue)
  d. VerifyMySQL(Name)
WriteFunction:return()

GRAPHICAL DATA PLOTTING

For visual display of the data to the users, a Gnuplot tool is utilized. Graphically expressing beam operation data in client computer screen required establishment in connection with PHP and Gnuplot. That is, PHP reads the data stored in MySQL and Gnuplot expresses the data in a more graphical way easier to understand. The interface between web program and Gnuplot displays the data in the client computer screen in HTML after temporarily storing them as PNG-type file. While inquiring data, diverse data search options are provided, such that several

PV data are inquired, one PV may be inquired during any arbitrary time or period, or Min value or Max value for the Y axis of the displayed values may be configured and displayed. It takes approximately 30 seconds to inquire the data for one month about one particular PV. Figure 4 is the screen to select data and Figure 5 is the picture of the plot for the actual data.

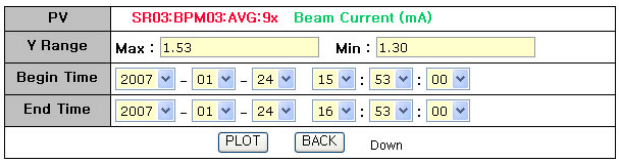

Figure 4 : Popup window for data select.

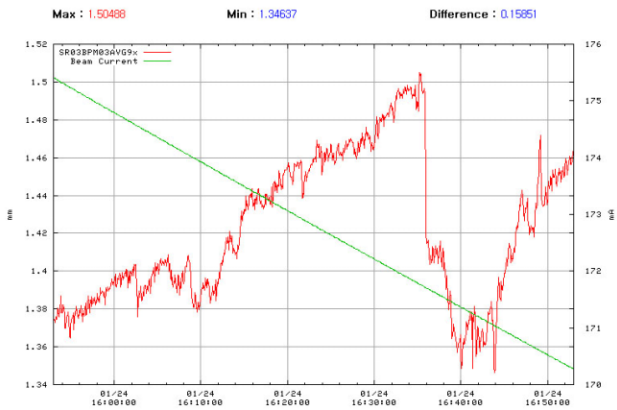

Figure 5 : Data Graph for One PV.

TEST RESULTS

Table 1 is the Bench Mark test results of the previous system and the new system. As for the test method, measurements were performed by using hdparm and time, the linux commands.

Table 1 : Performance comparison with the Existing System.

Items	New System	Exist System
CPU	3.4GHz Single	1Ghz Dual
Disk Access Times	60.47MB/sec	53.78MB/sec
Chche Buffer Reads	1995.3MB/sec	609.5MB/sec
DB Search Times (Data for one month)	3.109 Sec	6.446 Sec

CONCLUSION

In order to improve the performance of PAL EPICS IOC Web Monitoring System, Intel/X86 PC System was selected, and Linux Fedora Core 4 was successfully installed in Intel platform. Web-based IOC monitoring system should be interactively developed using various software tools, however though there are certain limitation in organizing diverse functions, IOC Web Monitoring System was successfully completed of its development. As for hard disk access time, SATA HDD demonstrated excellent performance not as good as SCSI though, and also regarding database access time, it has shown the processing speed nearly two times compared to the existing system. As for the future upgrade plan, we are considering to diversify the perspective on web monitoring system and develop systems using archive viewers provided in EPICS site that effectively reflects the characteristics of the acceleration devices.

REFERENCES

[1] http://epics.aps.anl.gov/epics.
[2] http://www.redhat.com/fedora.
[3] http://www.mysql.com/.
[4] K.M. Ha, “Development for PAL EPICS IOC Monitoring System”, PAL Report, 2003.