# DEVELOPMENT OF WEB-BASED USER INTERFACE FOR BEAM STATUS MONITORING OF 100-MeV PROTON LINAC *

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*Abstract*

The goal of web-based user interface is to produce a user interface which makes it easy and efficient to operate the Korea Multi-purpose Accelerator Complex (KOMAC) facility. A web-based user interface for a beam status monitoring of the KOMAC 100 MeV linac and beam lines has been developed with accessing Experimental Physics and Industrial Control System (EPICS) Channel Access (CA) protocol and relational database. Web service is combined with EPICS CA protocol. As a result, a beam operator and user can monitor the beam status in real time by using a web browser of remote PC or wireless device. In this paper, we are describing the implementation of web-based user interface for a beam status monitoring of the KOMAC proton linac.

## INTRODUCTION

The Korea Multi-purpose Accelerator Complex (KOMAC) control system was designed into the basic control structure of three groups including the central control system, the local control system, and the console system [1]. The central control system includes the timing synchronization and interlock. The local control system is responsible for the distributed control system for several linac components, such as the vacuum, power supply, data acquisition, RF, and so on. The console system is responsible for the user interface as a control system client. In order to implement the control system, we have adopted an Experimental Physics and Industrial Control System (EPICS) software framework as the standard development tool [2]. The integrated control system was realized by implementing a networked control structure of the distributed control systems for the 100-MeV proton linac, as shown in Fig. 1.

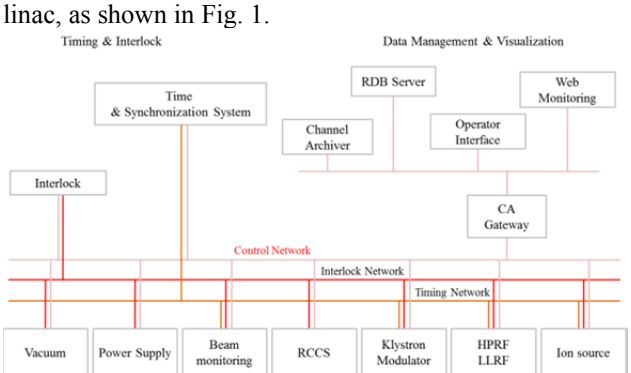


Figure 1: Structure of the control system for the KOMAC 100-MeV proton linac.

The control system includes a real-time monitoring and alarm functions. In the aspect of efficient monitoring, web-based user interface system was implemented using web server and WebPda [3]. The web monitoring system is also integrated with EPICS Archiver Appliance [4] and alarm system. The web user interface provides web browser which makes it easy and efficient to operate the KOMAC facility. A web-based user interface is combined with EPICS CA protocol. Operator and user can monitor and download the log data in real time by using a web browser of remote PC or wireless device.

## WEB INTERFACE

The web-based monitoring system presents many parameters about the sub-systems currently in use [5]. The Process Valuables (PV) data transmitted from all the IOCs are collected by the Data Converter Module (DCM). The DCM access field data of each record in IOCs and convert MySQL data format. Converting data from DCM is stored in MySQL databases. The DCM is developed by using EPICS CA and database library. The CA is a protocol used to establish connections to PVs. Once a connection has been established, it is possible to read or change PVs values, or monitor their values. The DCM implemented by using CA library is connected to the MySQL library based on C language. The DCM records the access times of CA. The PV data converted in the DCM are periodically forwarded in MySQL database. A web client plots data from MySQL databases. The web application consists of PHP, HTML-embedded scripting language. It is implemented by MySQL query instructions through PHP programming. The PHP receives responded information on user requests, pass them to CA, and generate a HTML page. A graphical plotting viewer of data searched by web clients is displayed using Gnuplot tool. In order to run the Gnuplot binary, another process from the Perl program was spawned. The web interface needs to be improved in terms of retrieval and plot speed.

## NEW WEB INTERFACE

There are several servers connected to EPCIS PV including archiver appliance, log server, save/restore, alarm, and relation database. One of essential requirements for web-based interface is to integrate all the servers. Our strategy is to implement web-interface application with a CA protocol using WebSocket [6]. WebSock based Process Data Access (WebPda) was adopted with Glassfish WebSocket server [7]. WebPda-based web interface includes real-time PV monitoring and alarm status. The web-based interface is also combined with archiver appliance as illustrated in Fig. 2.

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ISBN 978-3-95450-147-2

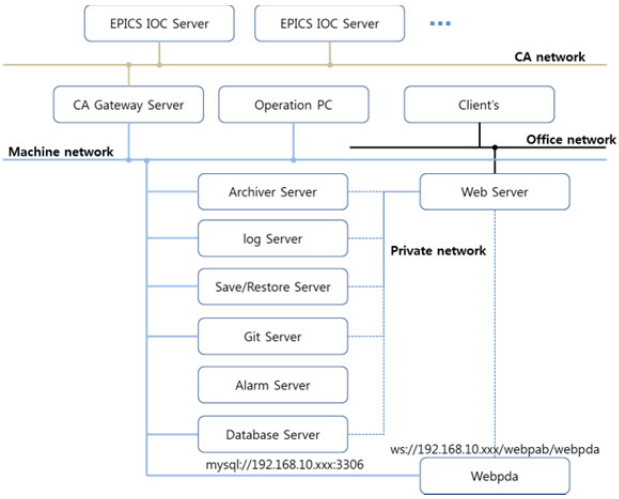


Figure 2: Schematic diagram of data management servers for control PVs

## *Data Management*

The data management system includes EPICS Input Output Controller (IOC), Operator Interface (OPI), and Relational Database (RDB) server, Alarm servers, log server, and save/restore server. The KOMAC IOC has about 8,000 PVs with various records as shown in Fig. 3.

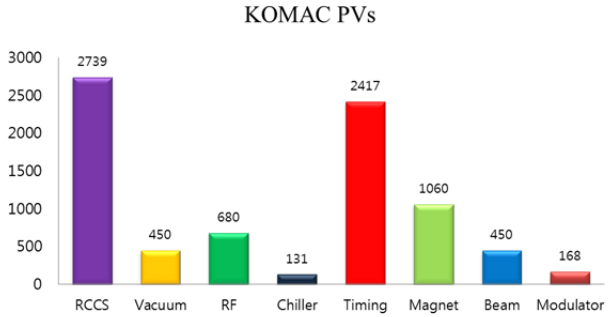


Figure 3: Process variables (PV) for channel access (CA)

Two types of archiving system for KOMAC facility have been used. The major parameters and data for a long observation period are stored in the data archiving system based on CS-Studio [8]. Some parameters and data that are required during the experiment are recorded by the channel archiver. The channel archiver scans the PV values every second with channel access. Data were stored in a specified directory. The data were archived at 220 MB per day. If the number of PVs reaches about 4000, the archived data capacity will be 8.8 GB per day. A 1 TB hard disk is used for about 120 days. Through the archive viewer, we can load the required data; plot the data and export data in a spread sheet and much more [9].

## *WebSocket-based web interface*

The web user interface on the control system can search PVs using WebPda. WebPda is a protocol to access PV using standard WebSocket technology. WebPda provides a simple and general way to push real-time changing process data to the web. The WebSocket protocol aims to solve these problems without compromising security assumptions of the web. As a WebSocket server, Glassfish is used for the Java EE platform. Figure 4 shows web user interface for monitoring beam current and operation status.


Figure 4: Beam current and status monitoring system using WebSocket based Process Data Access (WebPda) with Glassfish WebSocket server

A drawback of two archiving systems is to have to restart the system for changing the PV archiving configuration. In terms of fast storage and retrieval, the EPICS Archiver appliance was adopted. It is also possible to change the PV archiving configuration without having to restart the system. The archiver appliance can manage the system using a web based user interface such as the PV archiving configuration. The archiving configuration is typically stored in a MiriaDB database. Figure 5 shows archiver appliance web user interface linked with web interface of beam current and operation status.

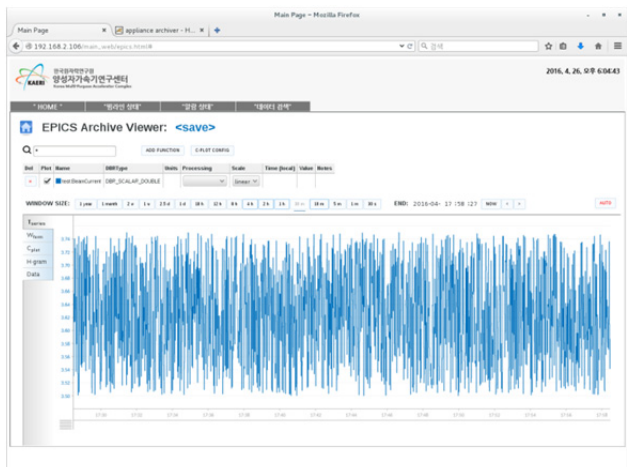


Figure 5: Archiver appliance linked with web user interface

The MariaDB consists of databases for alarm server, log server, save/restore server, and archiver appliance. The alarm server provides alarm information for web browser and client application. The alarm browser for easy access is shown in Fig. 6. There are two alarm clients to access alarm data source. One is alarm server for forwarding PV to alarm database. The other is a web

browser that monitors PV alarm status. The web user interface presents alarm status and all the log messages.

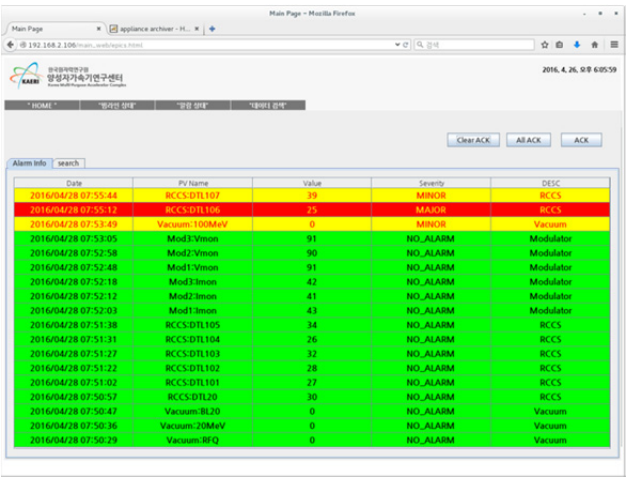


Figure 6: Web browser for monitoring alarm status

## CONCLUSION

The web-based user interface is being built to demonstrate that web browser makes it easy and efficient to access control system data. The web browser makes it accessible anywhere, anytime. Users will be using the web user interface as well as CS-Studio and Archiver-viewer after installation.

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ISBN 978-3-95450-147-2