Transactions of the Korean Nuclear Society Spring Meeting
Jeju, Korea, May 19-20, 2022

Design and Implementation of the Graphical User Interface based on CSS for the KOMAC LINAC and Beamlines

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1. Introduction

Korea Multi-purpose Accelerator Complex (KOMAC) has been operating a 100MeV proton linear accelerator. The Linear Accelerator (LINAC) is designed to accelerate a 20mA, 100MeV proton beam. The accelerator has been controlled and monitored in the integrated control room. For the sake of integration and security, the networking system was configured by the closed network and the distributed system. The integrated system can be operated stably if it was configured using the Experimental Physics and Industrial Control System (EPICS) Process Variable (PV) gateway. [1][2] The gateway has managed the PVs for load balancing and security. The schematic of the network is shown in figure 1.

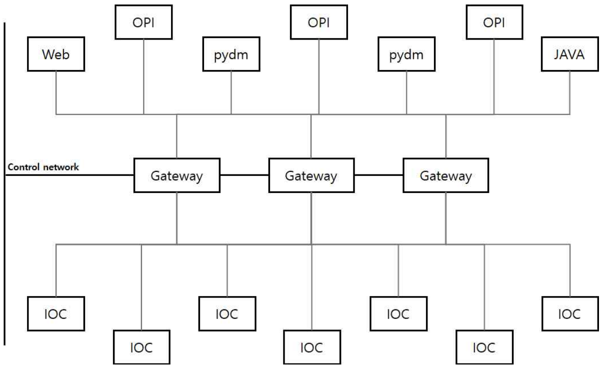

Fig. 1. The KOMAC control network with the PV gateway.

Operation Interfaces (OPIs) that are a Graphical User Interface (GUI) are built based on the Control System Studio (CSS). CSS is a tool based on eclipse for development and display. [3] As a result, the server and client were configured with the EPICS Input Output Controllers (IOCs) and CSS OPIs.

This paper introduces the monitoring system that was upgraded during maintenance time. The bulletin board system that displays operation-ready status will be focused especially on.

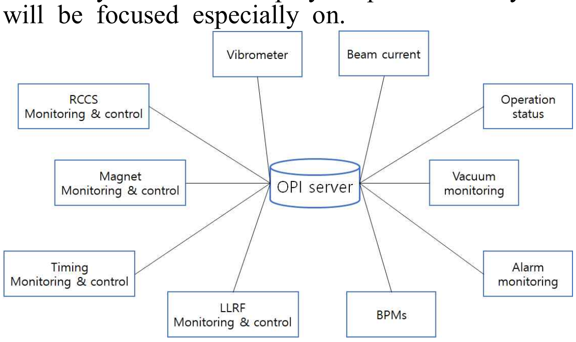

Fig. 2. The graphical user interfaces for the KOMAC with the OPI server.

2. The KOMAC OPIs

The OPIs have been managed on the OPI server. Each client can access the server using Secure Shell (SSH). This server is similar to the git server. It manages to interface files by version. All the files are uploaded if the file was revised. Likewise, the clients can download revised files from the server.

After the client downloaded all the user interfaces, it can access them from the main interface. The main interface is shown in figure 3.

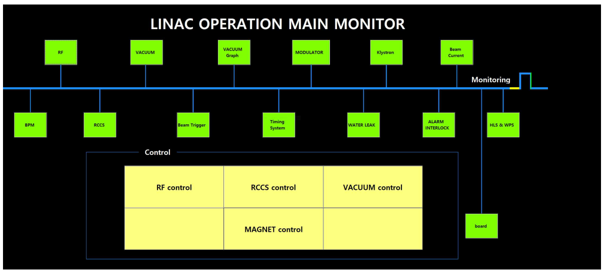

Fig. 3. The main interface that's accessible every of the interface.

When the operator wants to change another interface, just click the button. After the operator finished the work, click the main button to go back. Because every client applies this interface, the operator can access it easily anywhere.

The OPI based on CSS can display status dynamically using Javascript or Python script. The script can also calculate some formulas in the local environment. The KOMAC operation interfaces were already applied from many scripts for visualization. Major information has been shown on the bulletin board system in the control room.

3. The improved monitoring environment

During the maintenance time, the major change point is the interlock system using a key box. The key box was used only display for the operator. But now, when the key turns in the key box, the

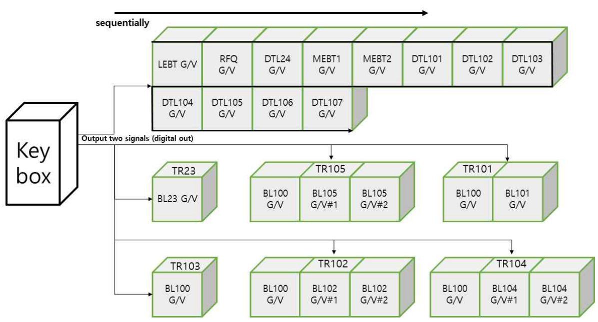

Fig. 4. The gate valves linked with key box flag signal.

gate valves open sequentially. If the key turns off, the gate valves also close sequentially. If the LINAC gate valves close at least one, the beam trigger isn't activated. The key interlock system is built on the EPICS IOC with a sequencer module. [4] The working mechanism is shown in figure 4.

The status of gate valves can monitor immediately on the main status interface that is configured with four linked monitors in a row. The main interface is shown in figure 5. The whole size of the display is 830 mm*5800 mm.

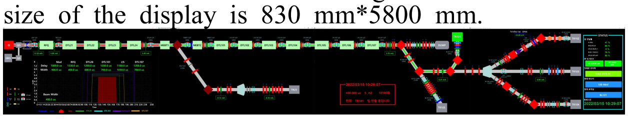

Fig. 5. The main interface with four monitors.

When the status was changed, each color of the object is changed if the value of the trigger PV is changed from the Javascript. The gate valves are designed to move dynamically when the status changed. Figure 6 shows the before and after status.

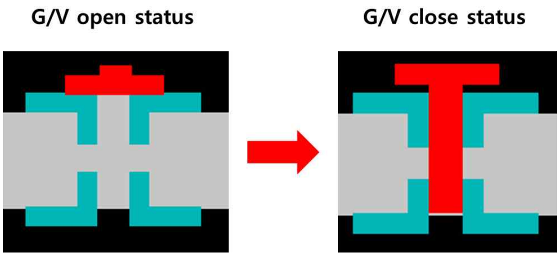

Fig. 6. The opening and closing of the gate valve.

The accelerator operation-ready status is shown in figure 7.

Fig. 7. The accelerator ready status

When the operator selected the target room, change the setting of the key, magnet, Resonance Control Cooling System (RCCS), Radio Frequency (RF), etc. And some values are monitored, such as the degree of vacuum, energy. Furthermore, check if the status is normal operation. These steps can check at once on the interface that figures out in figure 7. If the accelerator was ready, the target name is changed to target ready and the red box appears on the whole border. Each block monitors the PVs live. If the value was changed, the script works for each corresponding block. Each block has one Javascript file. The PVs are grouping and output just one flag in order that duplicated monitoring is minimized. The schematic is shown in figure 8.

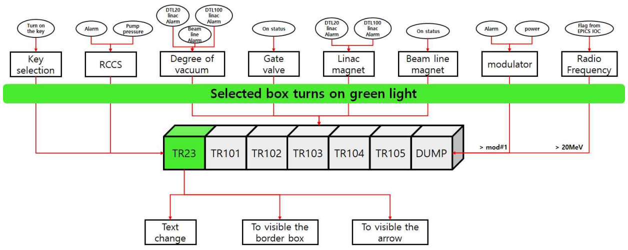

Fig. 8. The schematic of the ready status when the target room is selected to TR23.

The number of scripts is 48 files and the monitored parameters are 380. Since the interface displays the ready status, human error will be decreased remarkably.

As in the introduced interfaces, The control room has been changed with the goal of a user-friendly environment and intuitive visualization. The schematic is shown in figure 9 and the completed landscape of the control room is shown in figure 10.

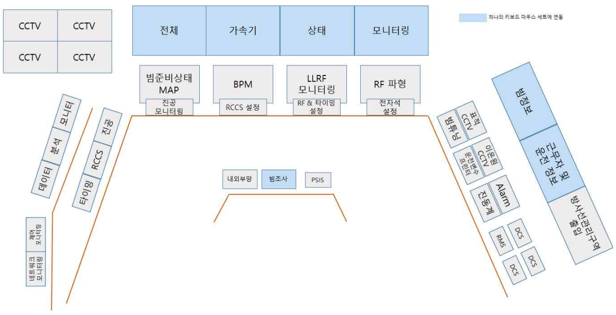

Fig. 9. The layout of the control room.

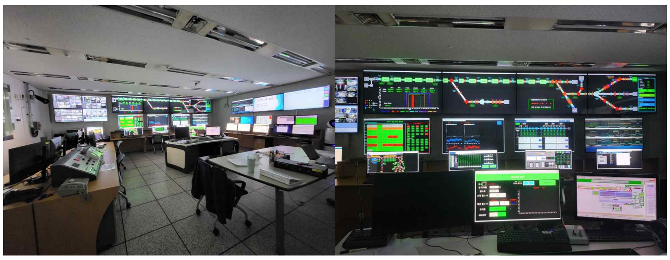

Fig. 10. A panorama view of the control room.

4. Conclusions

Graphical user interfaces have been monitored and developed by CSS, Matlab, and Python. But the interfaces of monitoring and control have almost been built by the CSS tool. The design philosophy pursued intuition, dynamic display, and user-friendly configuration. These apply to the introduced interfaces. As shown in figure 10, the application has been completed, and debugging is in progress.

REFERENCES

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[2] https://epics.anl.gov/extensions/gateway/index.php
[3] https://controlsystemstudio.org/
[4] https://www-csr.bessy.de/control/SoftDist/sequencer/