EPICS Control System for RAON Diagnostics

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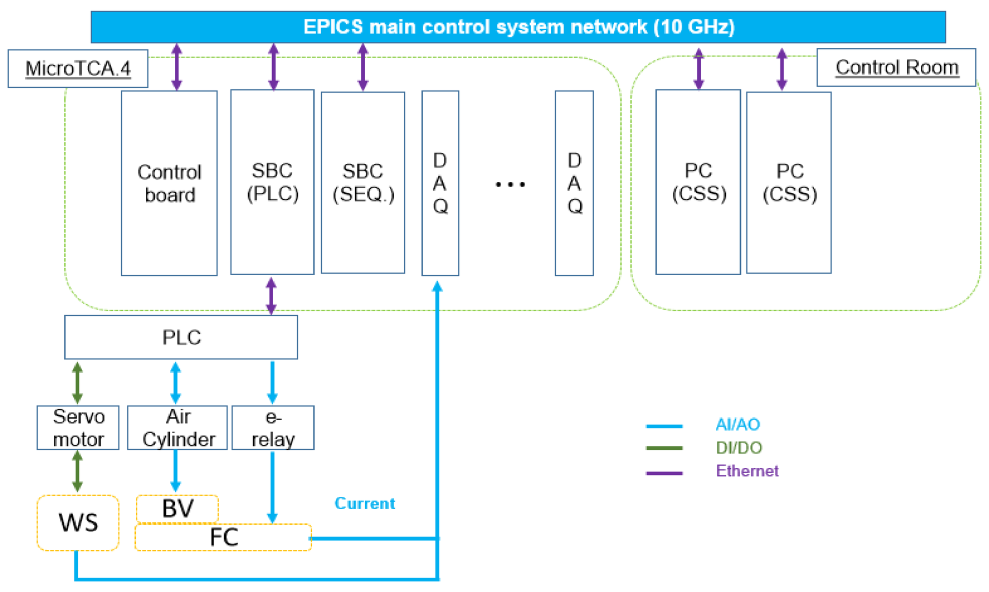
Abstract

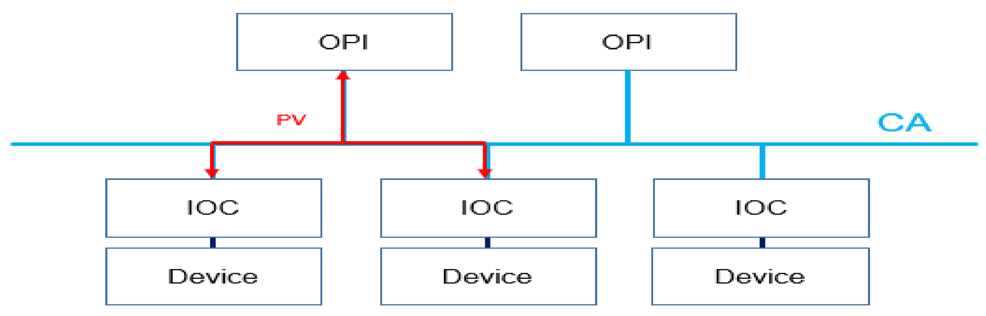
RAON has a variety of diagnostic devices for measuring beam characteristics, such as FC, WS, and BV, etc. Each device is driven through a PLC and acquires data with a DAQ. The whole system is controlled through EPICS and is displayed OPI of CSS. PV created in PLC, DAQ are aliased according to the naming convention. EPICS SEQUENCER are written in FSM code to step through the operation of each device sequentially. Below we show the working principle of the device and its algorithm and measurement results.

Introduction

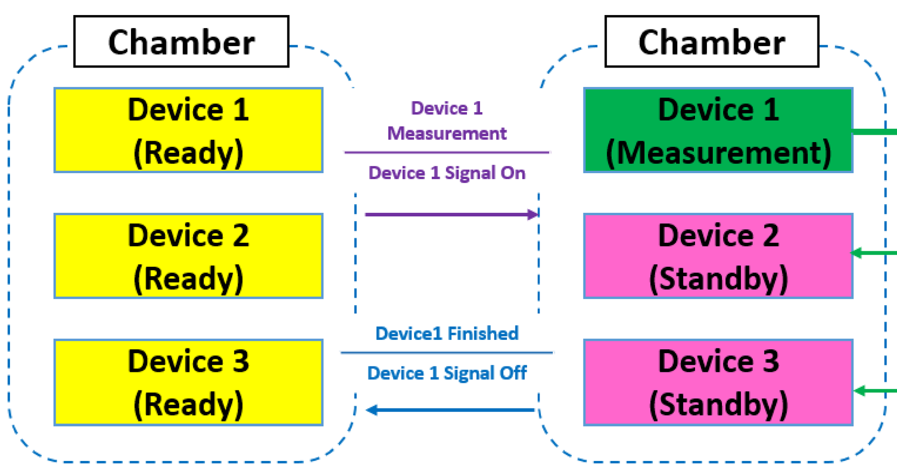


RAON has a variety of diagnostic devices such as Faraday Cup(FC), Wire Scanner(WS), and Beam Viewer(BV). Experimental Physics and Industrial Control Sys-tem(EPICS) is adopted to efficiently control many devices. Device is managed through EPICS PV and sequential operation is performed through SEQUENCER. microTCA has two Single Board Computer(SBC), Data Acquisition(DAQ) that acquires data, and a Control board that controls DAQ. SBC and Control board are connected to the main system through ethernet and the EPICS IOC is running. One SBC is used as Programmable Logic Controller(PLC) IOC and PLC is used to controlled Servo Motor of WS and Air Cylinder of FC and BV and E-relay. In DAQ, current of WS and FC is obtained, and it is connected to the main system through Control board. Another SBC IOC has a SEQUENCER module, which is used to operate devices in sequence. CS-Studio(CSS) Operator Interface(OPI) provides a display of control system.

EPICS Control System

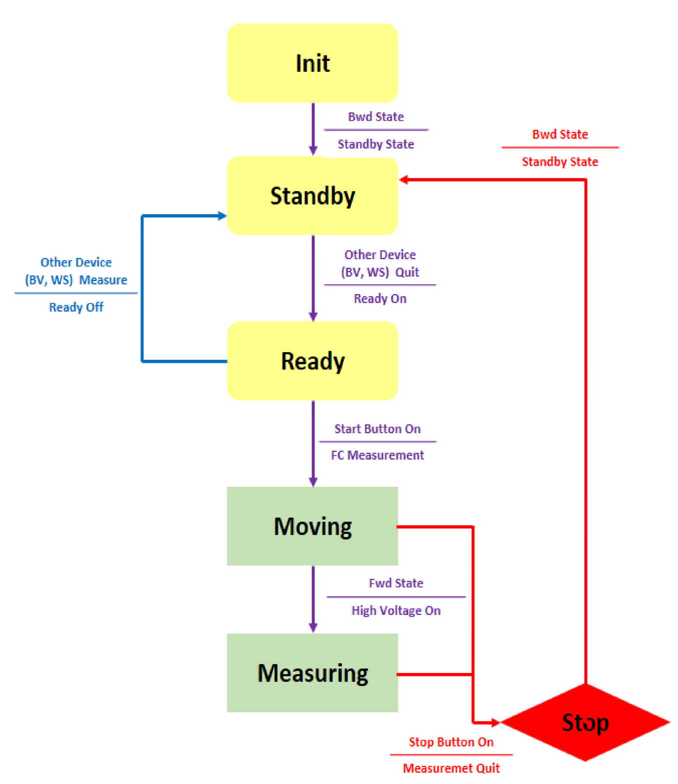


EPICS is used to implement distributed control systems for large-scale experiments. It uses a server/client based SCADA architecture. EPICS consists of IOC that transmits and receives data of device, OPI to display data and control experiments, Protocol Channel Access (CA) used for data distribution and PV to which data is transferred item.



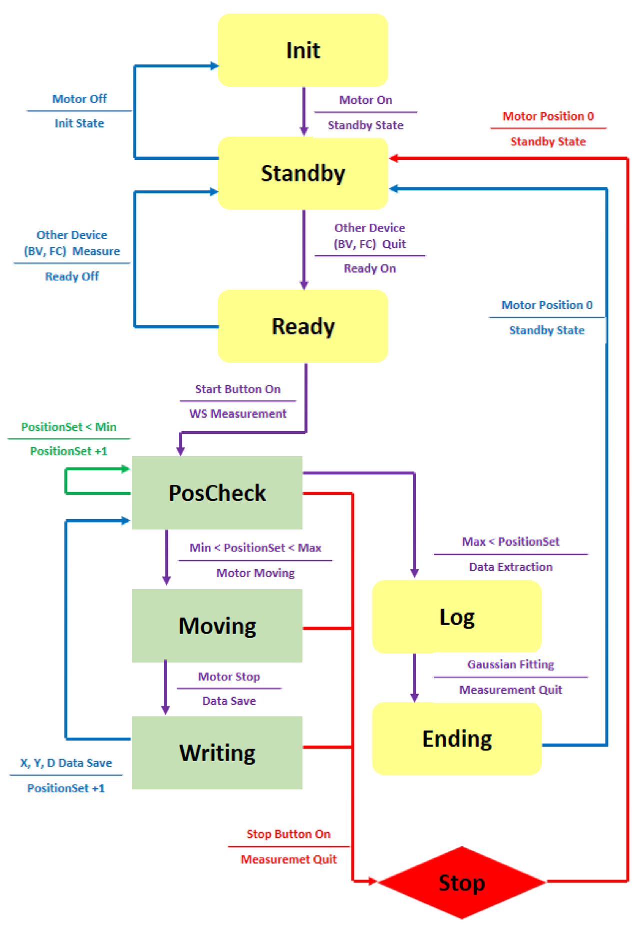
Several diagnostic devices are installed in single chamber. Interlock system was prepared to prevent a possibility of failure such as broken wire in WS, Conflicts between devices. All devices are Ready state. When Device 1 starts measuring, it sends a signal and other devices transitions to a Standby state. Measurement cannot be started in the Standby state. When the measurement of Device 1 is completely finished, the status of all devices is transitioned to Ready state.

Faraday Cup Sequencer



FC SEQUENCER starts in the init state. When the device is in the backward position, it transitions from the initial state to the standby state. When pressing the start button in ready state, moves the Faraday Cup to the inside of the chamber. When the Faraday Cup goes to the measurement position, the high voltage turns on and starts the measurement. The measured value is the value obtained by calibrating the current read from DAQ. Measurements are displayed in the monitoring OPI. when the end button is pressed, the high voltage is turned off, the cylinder is pulled back, and it enters the standby state.

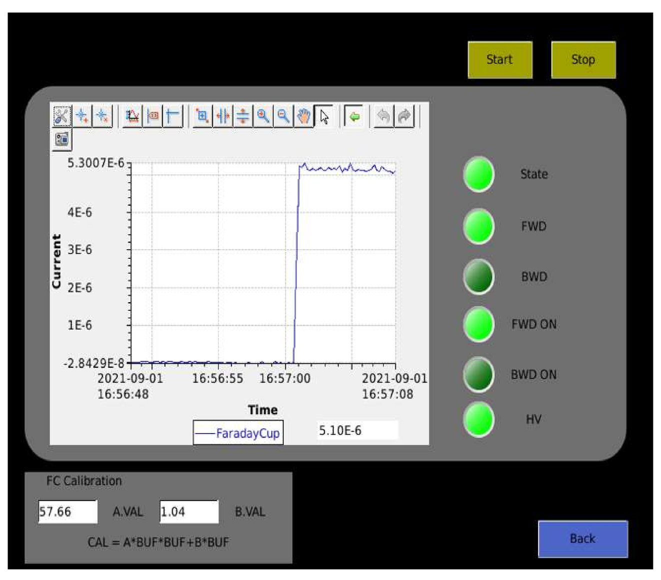
Wire Scanner Sequencer

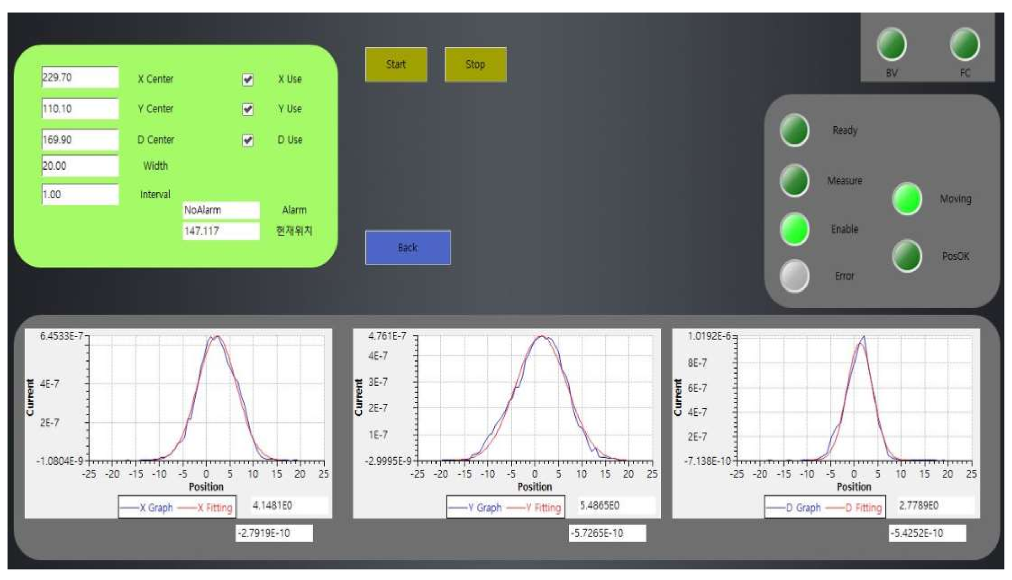


Schematic diagram of WS SEQUENCER. When the motor is powered on, it transitions from initial state to the standby state. If there is no influence from other devices, it transitions to the Ready state. We can set the measurement condition such as range, interval of WS in Ready state. When the start button is pressed, the position to be measured is checked first. When the measurement range is confirmed, servo motor moves to that position. Then stops and records current and position. Since the WS is inserted at a 45 degree angle, the X and Y axes have a compensation between the motor position and the recording position. Execute these corrections in the writing state. Diagonal (D) is recorded as the motor position. Repeat positioning and measurement until all set ranges have been measured. After the measurement, the center position and sigma value are calculated through Gaussian fitting in the python EPICS module. After all measurements are completed, it returns to the position and enters the standby state.

Control OPI

It shows the Monitoring OPI of the injector. We can check the vacuum level of the beam line and whether the gate valve is open or closed. Real-time display of current from FC and ACCT so we can see only what we need. In addition, the current status of each diagnostic device can be checked through the LED.





The Faraday Cup OPI displays the measured current and the status of the pneumatic cylinder. It can input a calibration value to compensate for the current loss in the cable. Since the operation sequence is written in the SEQUENCER, it can use by pressing just the Start/Stop button.

The Wire scanner OPI displays the measured current and position. And it can set the measurement options for WS. Options include whether the axis is measured or not, the center position, the measurement range and interval. When pressing the start button, it follows the sequencer to measure. It can stop at any time during the measurement.

The values shown on the OPI are the actual beam measurements.

Conclusion

Beam diagnostic device was installed in the injector section, and control and measurement were performed using EPICS/CSS. Sequential operation and interlock system based on SEQUENCER also confirmed no problem. Whenever an error occurs in SEQUENCER, it is being fixed. Research is underway to measure the beam of the injector and make an optimized beam for the acceleration part. The installation and control of diagnostic de-vices in the SCL3 and P2DT sections are also being pre-pared.

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