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CONSTRUCTION OF A REMOTE CONTROLLED MONITORING SYSTEM WITH GPIB DEVICES AND EPICS

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Abstract

The Experimental Physics and Industrial Control System (EPICS) has been used for the accelerator control system in recent years. EPICS has rich set of tools to create application with Graphical User Interface (GUI). It reduces the load of complex programming for GUI and shortens the application development period.
This paper will describe the remote temperature monitoring system using EPICS.

1. Introduction

Slow drift of a beam orbit in TRISTAN Main ring is observed during a long time operation. It caused the degration of the performance of the machine.
One reason for this slow drift has been thought as the temperatures of magnets in the ring. Drift of temperature can affect the orbit of beam through the thermal expansion of electromagnets and its supports. We build a system to monitor the temperatures in the accelerator tunnel to study correlation between the temperature drift and the beam orbit drift.
Thermocouples are used as temperature measurement device. Data collected by thermocouple controller are sent to a VME computer through GPIB/LAN (local area network) linker. User can control and monitor this system by EPICS tools.

2. EPICS

EPICS[1),2)] is a scalable, distributed process control system that is built on a software communication bus called Channel Access. EPICS architecture includes the UNIX workstations for executing high level applications (including operator interfaces), and single board computers as front end computers, called Input Output Controllers or IOCs. The single board computers in VME crates are used as IOC. Communication among the distributed components is over TCP/IP sockets, via ethernet or FDDI.

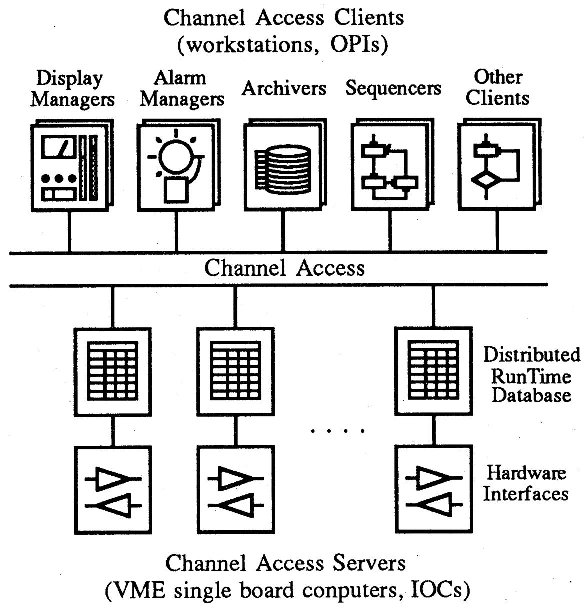

Figure 1. Functional subsystem layout of EPICS. The only sequencer runs on both OPI and IOC.

The EPICS architecture provides a wide range of functionality, rapid application development and modification, and extensibility at all levels to meet the demands of experimental physics. The hardware and software for each functional subsystem were selected to meet these requirements. The subsystems are: the Distributed Database, the Display Manager, the Alarm Manager, the Archiver, the Sequencer, and Channel Access (see Figure 1). These functional subsystems greatly reduce the need for programming. Sequential control is provided through a sequential control language, allowing the application developer to express state diagrams easily. Data analysis of the archived data is provided through an interactive tool. The system is scalable from a single test station with a low channel count to a large distributed network with thousands of channels. All data is passed through the channel access protocol. One can extend the basic EPICS system in IOC by creating new database record types, calling 'C' subroutines from the database, extending the driver support and creating independent VxWorks task.

3. Monitoring System

We built a monitoring system for the temperature measurement with EPICS. The reasons why we employed EPICS are:

1) No need for programming except driver support.
2) Easy modification for the monitoring system.
3) Easy addition for the measurement channel.

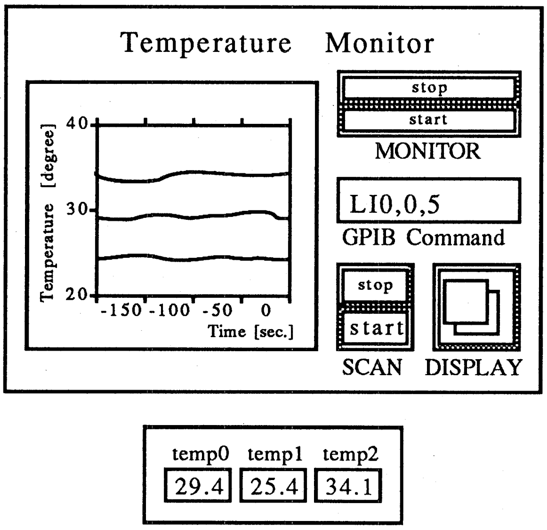

Figure 2. Control panel. The display panel for the current value of the temperature comes out if the DISPLAY button is pushed.

3-1. System functions

The functions of this monitoring system are:

1) Device control
   Transmit the GPIB command set on the control panel created by the display manager to the measurement system for the temperature (Figure 2 shows the control panel).
2) Status/ Data Display
   Display the current temperature and plot its last 200 seconds' history.
3) Data Archiving/Retrieving
   Record the temperature data measured by the measurement system for the temperature into the disk. And readout and displays the recorded data.
4) Alarm Notification
   Send the message to the specified user by an e-mail if there is no answer form IOC to OPI or the data from the measurement system for the temperature is same as previous data including the time stamps.

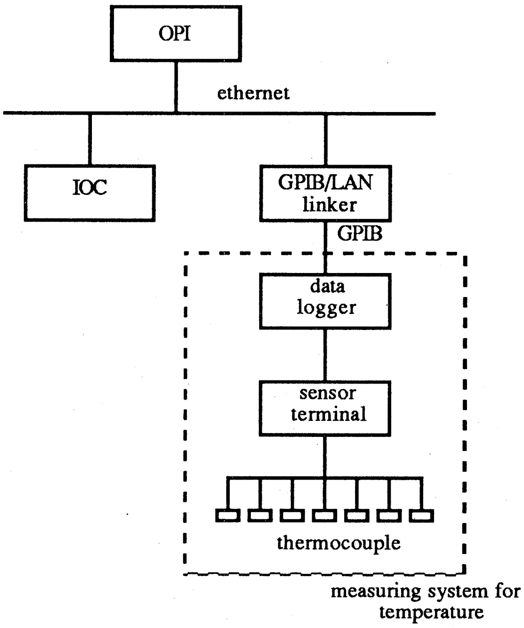

Figure 3. System architecture.

3-2. System architecture

This system consists of workstation, VME single board computer, GPIB/LAN linker, computing data logger, sensor terminal, and thermocouples. Figure 3 shows the arrangement of these components.

The functions and names of each component are:

Workstation
: HP 9000 workstation model 735/755 is used as an Operator Interface (OPI) in EPICS, and runs the UNIX operating system and a number of EPICS tools such as the archiver, the display manager and the alarm manager.

VME single board computer
: FORCE CPU40 is used as an Input Output Controller (IOC) in EPICS, and runs the VxWorks real-time kernel and a number of EPICS programs such as the distributed database and the sequencer.

GPIB/LAN linker
: SONY Tektronix ET488 exchanges the data from the data logger through GPIB to output to ethernet and performances a GPIB controller.

Computing data logger, sensor terminal, thermocouples

ADVANTEST TR2731, TR2741 and thermocouples compose a measurement system for the temperature.

Network

The network among the workstation, the VME crate and GPIB/LAN linker is ethernet on which the transmission speed is 10 Mbps.

3-3. Data acquisition

The process of data acquisition is as follows.

1) The operator initiates the start command for data acquisition on the control panel, to process the database record.
2) The database record issues the GPIB command which starts the sensor terminal or programming for the data logger.
3) The data logger starts the sensor terminal, complying with the GPIB command from the database record.
4) The sensor terminal collects the data from the thermocouples which are in the accelerator tunnel.
5) The temperature data collected by the sensor terminal are sent back to the IOC (database) via GPIB/LAN linker.

4. Conclusion

By using EPICS, there was no need of coding except the driver support for the GPIB controller, device support for the data logger and sequential control.

Another measurement point can be added to the system just adding a new record to the EPICS run-time database. User can easily modify the operator interface (control) panel using EPICS tools. Furthermore, by connecting the GPIB controller to LAN directly, we can place the GPIB devices in many places.

Acknowledgments

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