CLEO III Cooling Control and Monitoring

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Abstract

Cooling systems for the CLEO III detector require proper control and monitoring in order to protect the integrity of the electronics and to maintain mechanical stability (constant temperature control). In our system, all cooling loops are controlled by a single Small Logic Controller (SLC), a programmable off-the-shelf industrial process-control computer. We use LabVIEW (Laboratory Virtual Instrument Engineering Workbench) as a readout user interface for monitoring systems and for conveying alarm system information. We worked on designing a flexible user interface that has features such as visualizing each cooling loop and keeping track of changes in conditions, reading and recording the main system parameters, and implementing simple alarm systems.

Introduction

Although the detector and collision interaction regions of CLEO III occupy a relatively small volume, several kilowatts of unused power are released as heat. Further, there is the possibility for rapid and large temperature differentials due to accelerator beam currents, ambient temperatures in the collision hall, and local gradients between adjacent subsystems inside CLEO III. Thus, the cooling systems need to be flexible enough to deal with such unstable heat and temperature differentials. First, we designed the hardware cooling loops for each subsystem based on a generic cooling loop. Subsystems of CLEO III that require temperature control and monitoring are as follows:

Silicon vertex detector (SVX)
Ring imaging Cerenkov detector (RICH)
Drift chamber (DR)
Beam pipe

For the coolant of our cooling system, we chose the petroleum-based cleaning solution, PF200, whose thermal flow properties are similar to those of water. The advantage of using PF200 is that it is non-conductive and has a radiation length longer than water. Second, in control part, we used a single Small Logic Controller (SLC), a programmable off-the-shelf industrial process-control computer, which can be driven by a ladder logic program to control the system. Lastly, in the monitoring part, we used LabVIEW (Laboratory Virtual Instrument Engineering Workbench) as a readout user interface for system and alarm information.

Project Overview

Electronic sensors placed in the cooling loop send signals to the SLC. Via an RS-232 connection, the process-control computer, programmed with the ladder logic language, controls the SLC. The data from the SLC are transmitted using HighwayVIEW to LabVIEW, which is used for displaying and monitoring the system. Figure 1 illustrates the system overview.

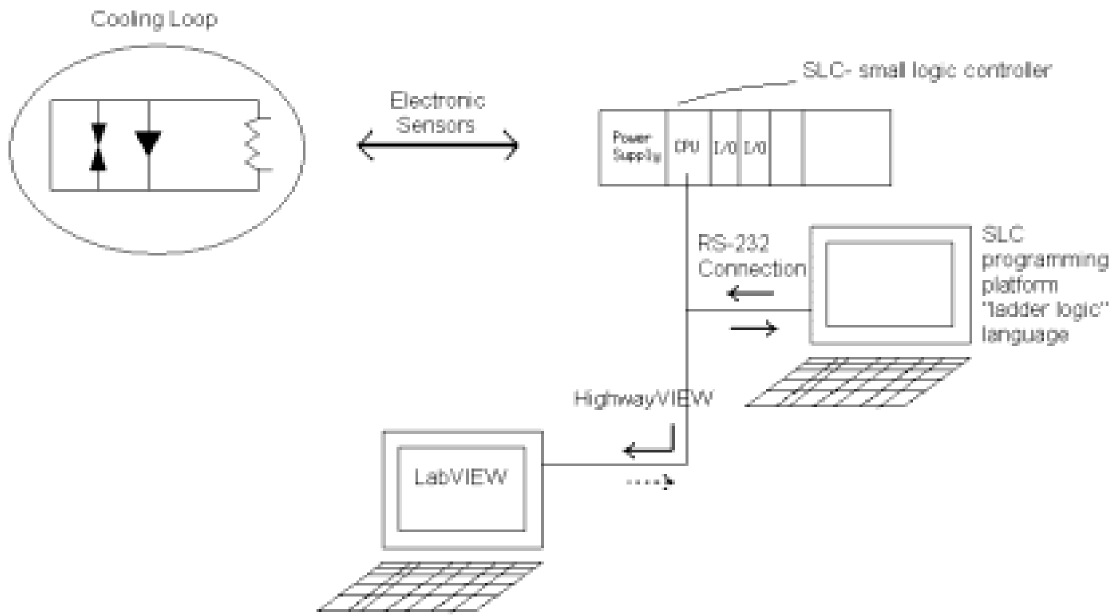

FIGURE 1. System overview diagram.

Monitoring system

For the user interface, LabVIEW is a good solution because it is a developme environment based on the graphical programming language G [1], which ma a graphical user interface. Cooling system monitor data can be present ways, and each demands a different user interface. For instance, the u Figure 2 is useful for visually monitoring the coolant flow as well as of the system.

On the other hand, the user interface shown in Figure 3 is useful for m parameters at once in relation to time. Each measurement is graphed on on the x-axis. Graphs are updated every 30 seconds. LabVIEW facilitat methods of presenting data.

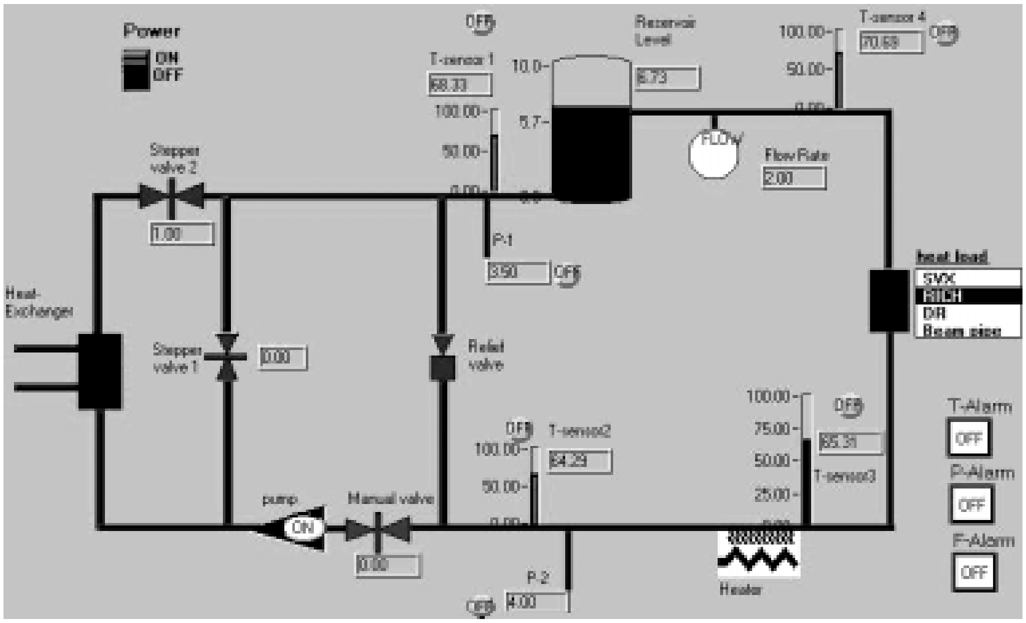

FIGURE 2. Cooling loop user interface.

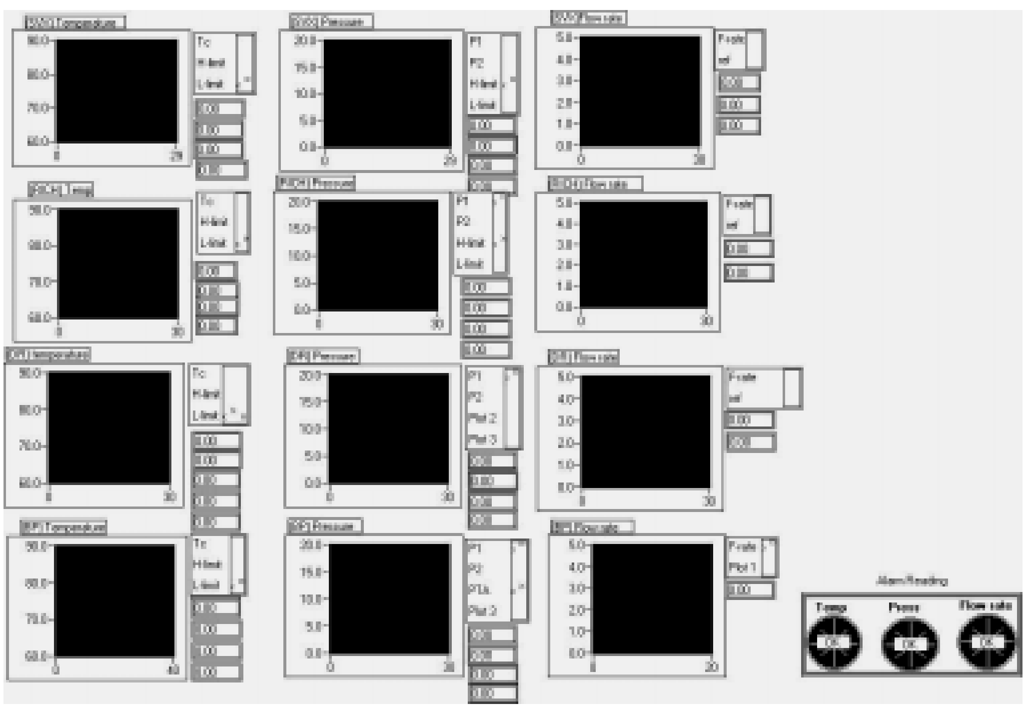

FIGURE 3. Time-data monitoring user interface.

Another advantage of using LabVIEW is that it is integrated fully with hardware. For example, communication with the SLC is easily made t HighwayVIEW, and for interaction with the CLEO III Slow Control system any other TCP/IP-capable language.

Conclusion and Plans

We worked on designing a flexible user interface that has features such as visualizing each cooling loop and keeping track of changes in conditions, reading and recording the main system parameters, and implementing simple alarm systems. We look forward to integrating our control and monitoring systems into a prototype cooling loop whose construction is nearing completion.

Acknowledgments

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Footnotes and References

1. LabVIEW QuickStart Guide.