"Virtual Instrumentation" for monitoring the purifying installation from Cryogenic Pilot Plant with Remote Data Acquisition

by
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Category:
R&D

Products Used:
DAQ Instruments-Interface AT-MIO-16-XE-10
Signal Conditioning – SCXI™ 1100 – multiplexed mode
NI-DAQ™ version 6.0 with RDA
Ethernet LAN
LabVIEW™ 5.0

The Challenge:
To develop a data acquisition system for purifying module from Pilot Plant for tritium and deuterium separation and acquire data over network using a National Instruments DAQ board AT-MIO-16XE-10 installed in a remote computer which is located in data acquisition room from tritium separation installation.

The Solution:
The purpose of this application is to accomplish remote data acquisition when there is no network in place and for security and protection in cryogenic pilot plant. Because RDA is used on any existing local area network we can run application on our computer (the RDA Client) that uses National Instruments data acquisition devices located in another computer (the RDA server) which is connected to our computer via the Ethernet hub.

Introduction
The raise of tritium level concentration in heavy water determines some problems in operation of nuclear reactor and also for the environment. Therefore it is very important to decrease the tritium level in heavy water and in this way most owners of Candu reactors are making researches and develop technologies for heavy water detritiation. In Romania it is functioning a nuclear power plant of CANDU type. As it is well known after several years of functioning the radioactive level in the moderator attained such a value that imposes heavy water detritiation. Therefore at the Institute of Cryogenic and Isotope Separation is developing a research program for tritium separation from heavy water. For this purpose there exists an experimental facility “Pilot Plant for Tritium and Deuterium Separation”. One of the plant components is the purifying module where the deuterium is burned in the catalytic reactor for eliminating oxygen and after that is made an advanced drying on molecular sieves. For resolving many problems from isotopic exchange installation, we use a personal computer, LabVIEW 5.0 software, DAQ board- AT-MIO-16XE-10 and SCXI-1100 signal conditioning to acquire, control and display test data for purifying installation from Cryogenic Pilot Plant (Figure1).
Performances
Considering the number of parameters (temperatures, pressures and levels) from the installation we chose the SCXI – 1100 with 32 differential channels. The selectable gain and bandwidth settings are ideal for configuring the module to condition a variety of millivolt and volt signals and SCXI module multiplexes the 32 channels into a single channel of the AT-MIO-16XE-10.

We used SCXI-signal conditioning to electrically isolate the sensors and the monitored system from the DAQ system and the host computer. We leave the jumper W5, W2 and W9 in their factory-default position. All of the sources are floating, so we configured W1 to connect a 100 kΩ resistor to the negative input of the amplifier to prevent saturation of the amplifier inputs. We configure the RDA Server: PC with Windows NT, NI-DAQ-6.0 and LabVIEW 5.0 with data acquisition board AT-MIO-16XE-10 and SCXI 1100 in multiplexed mode. The RDA Client has Pentium Computer, 200 MHz, running Windows NT, LabVIEW 5.0 and NI-DAQ 6.0.

The RDA Server is installed in "data acquisition room" where we have all sensors from installation connected to SCXI 1100.

In figure 2 is presented the diagram block for RDA Setup with two computers connected together through Ethernet.
The DAQ Solution Wizard guides us through naming and configuring the sensors and signals connected to DAQ board (Figure 3).
Figure 3. DAQ Solution Wizard for configuring the sensors and signals connected to DAQ board- AT-MIO-16XE-10 and SCXI 1100.

More over the NI-DAQ library addressed by a LabVIEW source code allows to develop a system at a very low cost and with extreme ease of use.

Conclusions
This solution of implementation performs a large number of acquisitions, with many advantages from SCXI – signal conditioning. The gain is applied to the low-level signals from the SCXI module located close to the transducers, sending only high-level signals to the PC, minimizing the effects of noise on the readings.
All data acquired are saved in specified files and after that are used to determine the thermodynamic parameters associated to each measuring point (entropy, enthalpy, specific heat, liquid fraction was the case) - Figure 4.
We choused RDA server and RDA client because is very useful in purifying installation from cryogenic pilot plant where we have need for protection (in this installation exists many toxic and radioactive substances).
With these values we analyze the performances for the compounding elements (heat exchangers, turboexpanders, throttle valves) of the cryogenic cycle using the temperature-entropy diagram. We used the LabVIEW 4.1 programming because it is very simple to chart, analyze and save data. LabVIEW has given thousands of successful users a faster way to program instrumentation and data acquisition systems. By using LabVIEW prototype, design, test and implement, we can reduce system development time and increase productivity.