Gas Burner and Furnace Tester

Authors:
Jeff Scott, Senior Project Manager, Data Science Automation, McMurray PA
Paul Tortora, Senior Automation Systems Engineer, Data Science Automation, McMurray PA

NI Products Used:
LabVIEW 2012
SCXI-1600
SCXI-1100
SCXI-1102c
SCXI-1102
TC-2095

Categories:
Automated Test
Energy

The Challenge
Over 200 channels of data are required for the certification testing of gas burners. The complex scaling and analyses must be automated to allow testing to keep up with manufacturing.

The Solution
Create an application that allowed the user to create and retrieve multiple configuration profiles and route data to displays on several tabs. Modular software architecture allowed communication between modules handling acquisition, scaling, analysis, visualization, and logging of data.

Introduction
Data Science Automation (DSA) is a premier National Instruments (NI) Alliance Partner that specializes in automating and educating the world leading companies. Clients choose DSA because of DSA's deep knowledge of National Instruments products, disciplined process of developing adaptive project solutions, staff of skilled Certified LabVIEW Architects and Certified Professional Instructors, and unique focus on empowerment through education and co-development.

Lots of Data, Lots of Options
Our customer runs a successful and growing manufacturing business, due in no small part to their line of burners used for natural gas combustion. Quality control is a natural part of the manufacturing process, but testing was formerly tedious. The customer was logging data by hand. So they desired an automated process while at the same time adding many more channels of measurement data using NI hardware.

The customer took LabVIEW training classes in anticipation of developing a LabVIEW-based data acquisition system, but didn't feel quite ready to create an application from scratch for handling over 200 channels of data. DSA was tasked with creating an application to meet the following requirements:

- Create, save, and load channel configurations. A channel configuration consists of a list of data channels that include:
    - user-created name
    - I/O name
    - type of measurement (thermocouple or 4-20 mA)
    - pre-scale and post-scale
    - min and max (for range alarms)
    - the graphs/tables that these data are displayed on
- Include "calculated channels" which are quantities calculated from measured values, but otherwise treated the same with regards to logging and displaying.

- Channel configuration should also include 2 general options. The first is the data sampling interval. The second is a mode selection: where "log" mode logs all data at the specified interval, and "sample" mode only logs a set of data when the user triggers it.
- Display all data and range alarms on a large table.
- Display selected data on one of two plots specified as "Combustion" and "Miscellaneous."
- Display selected data on a table with enlarged text to be visible to an operator from a distance. Also give the operator the ability to change certain constants used in the calculated values.

Making Sense of it All

The main display was made as versatile as possible by placing the main controls for data acquisition and logging along the bottom of the screen (Figure 1) with the majority of the interface comprising a tabbed display that the user can use to view data in different ways (Figure 2). Upon startup, the user is presented with the configuration tab, with the other tabs disabled until data acquisition is started.

Most controls are initially disabled and grayed out and are only enabled as the user enters information, thus guiding the user without the need for explicit instructions. First the user needs to enter their identification, then create or load a channel configuration, and only then can data acquisition be started. Furthermore, the controls for automatic or manual logging are only available during acquisition. Log files are created and named automatically, with header information and formats configured to the customer's specification.

The user can configure all data channels with the options required initially by the customer (measurement type, units, min and max for range alarms, etc.). For the calculated values there is a convenient display of all equations used, as well as options to enable or disable each calculated value. Channel configurations can be saved to and loaded from INI files. Fortunately, LabVIEW's configuration file VI's made configuration file management straightforward.

During data acquisition, the user can use the remainder of the tabs to view the data in various ways. The configuration tab remains available so the user can view the channel configuration currently in use, but it's disabled because no changes to the DAQ configuration can be made while data is being acquired. The user can simply view all data and alarms in tabular format, view plots, or use a large display for when an operator needs to see important information from across a room. The large display also includes controls for modifying certain constants used in calculations which occasionally need to be corrected.

What's Under the Hood

This application collects a significant amount of data and provides extensive versatility, so a robust architecture was necessary. Of the many options possible with LabVIEW, we chose an architecture that featured three separate modules to handle the data acquisition, logging, and user interface, all communicating via queues (Figure 3).

This architecture allowed the application to use multiple threads to improve performance. The use of queues also encapsulated data and tasks and permitted handshaking between modules. Type-defined queues in addition to type-defined data allowed for a high degree of scalability.

NI Hardware and Software: So Happy Together

The large amount of data the customer required made the selection of an integrated hardware and software solution important for sticking to a budget. The SCXI hardware selected for this system allowed for a straightforward physical setup and since the hardware was accessible and configurable using the DAQmx API, software integration was a snap as well.

Our customer now has a streamlined quality control system with a data acquisition system that can be used by multiple operators. Since data was formerly collected manually, their productivity has been multiplied many times. Since the customer is also able to modify the LabVIEW code, the system is adaptive and maintainable. Things like different thermocouple types and additional calculated values can be added with ease.

Contact Information

Jeff Scott, jjs@DSAutomation.com
Paul Tortora, prt@DSAutomation.com

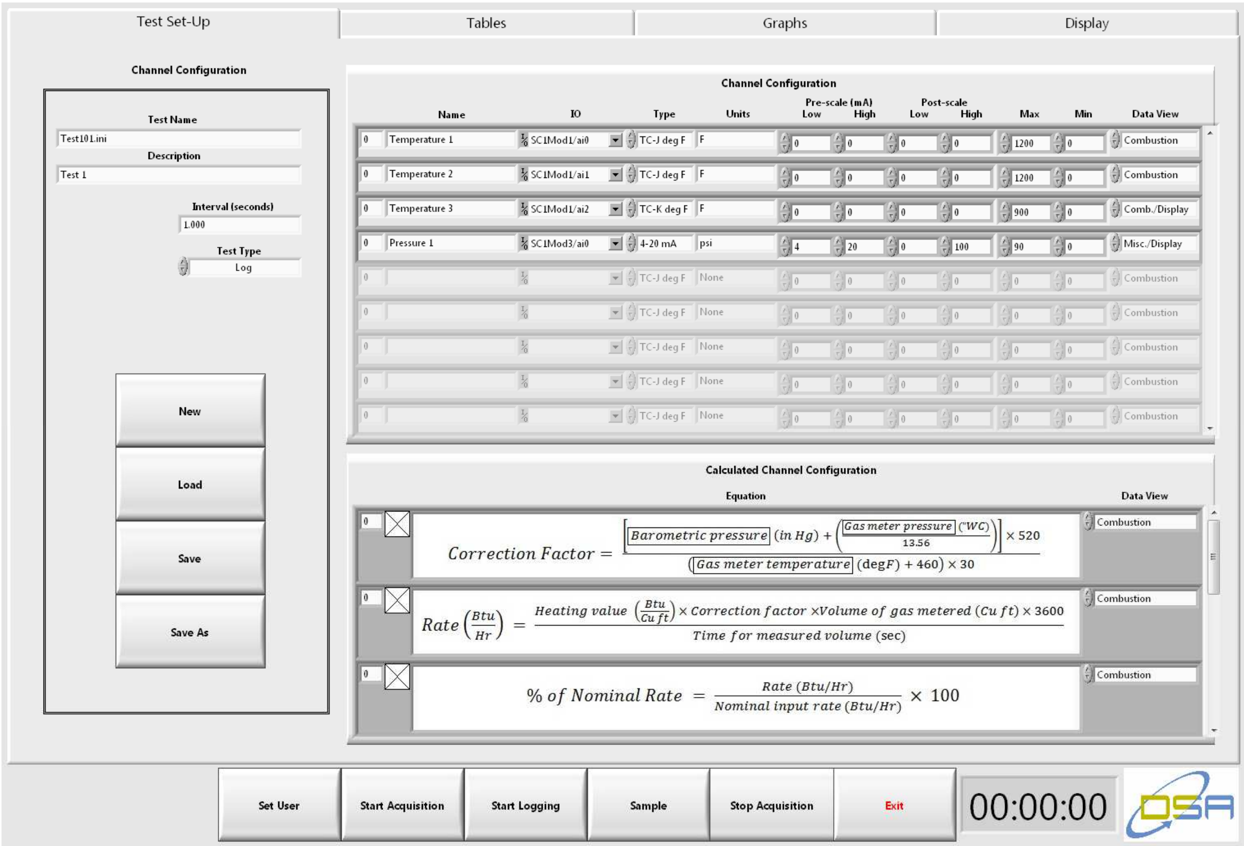

Figure 1 - A configuration screen allows the user to select physical data acquisition channels and assign data type, units, ranges, and plot assignments in any combination.

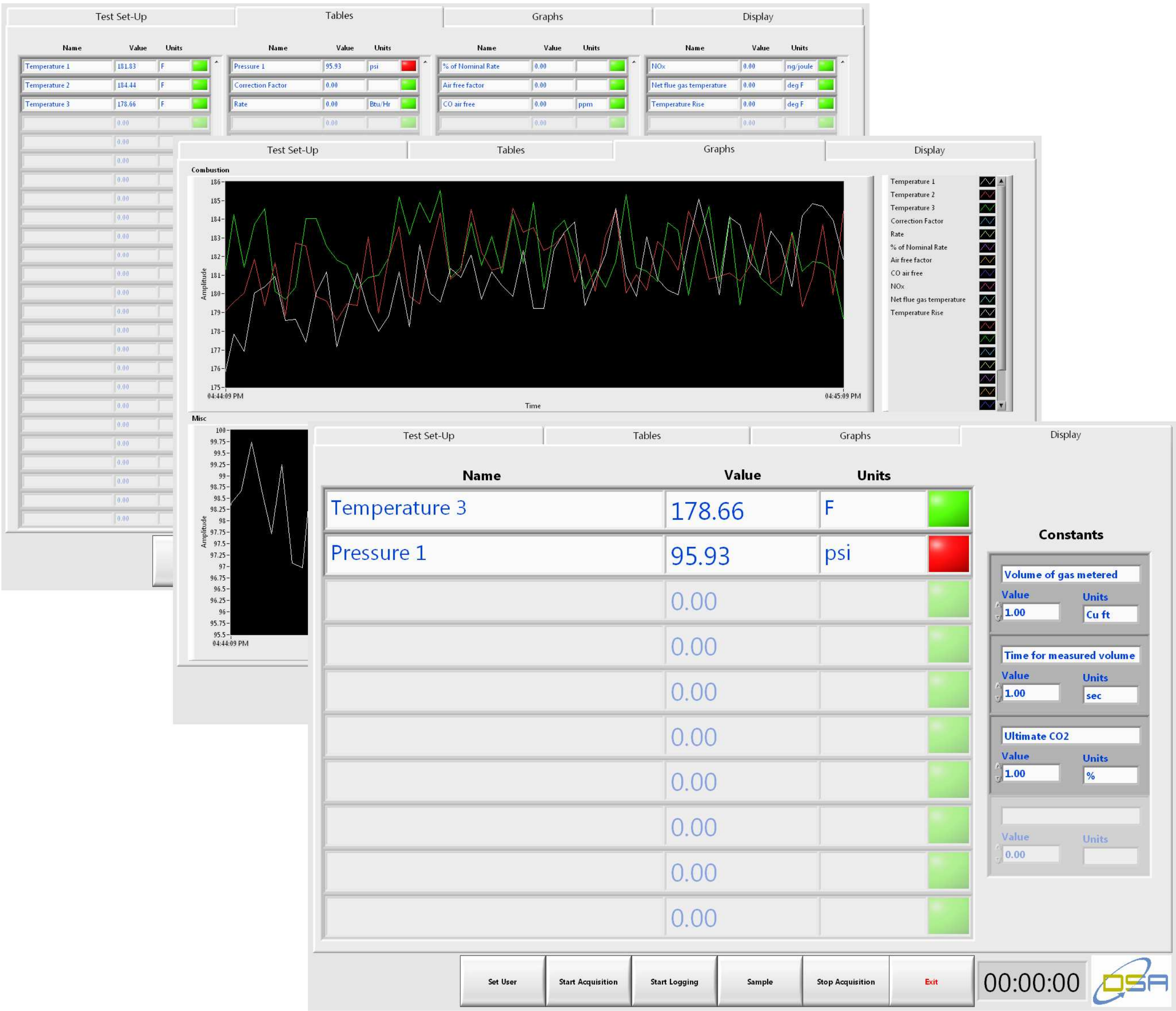

Figure 2 - Tabs allow the user to view the same data in different ways depending on the situation; for example, a large display allows the user to see important data from across a room.

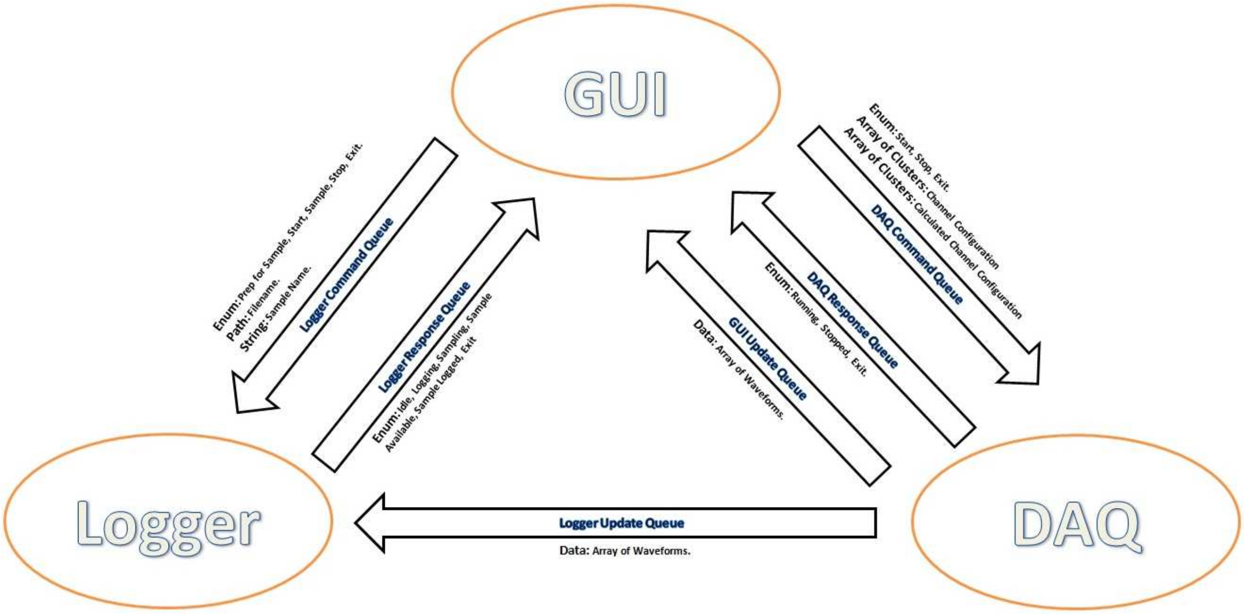

Figure 3 - A modular architecture allows the application to operate in multiple threads and encapsulates data and communication.