Detection of Hydrogen and Natural Gases for Next Generation Fuel Sources

The Challenge:

A natural hydrogen company focused on sourcing hydrogen in a clean, continuous, cost-effective manner from underground reservoirs needed to develop a fully autonomous gas analysis system capable of extreme low-level hydrogen gas detection.

The Solution:

Design a custom Testbed using LabVIEW® and National Instruments (NI) hardware to acquire data from various specialty sensors, residual gas analyzers, along with control of custom mechanical sample stage to collect and analyze sample data.

Enabling the Future of Clean Energy

The search for next generation clean energy sources is a key focus of the Department of Energy (DOE) and major companies all around the world. One area of interest is improving the sustainability of current production methods in the hydrogen energy sector. The detection and collection of these clean resources have become of utmost importance to reduce CO_2 and carbon emissions from current processes.

Lowering Sample Collection to Results Delay

Known for advanced system design and LabVIEW expertise, ADVINT was contracted to design and build a custom gas analysis system for the detection of hydrogen and other natural gases. This system is deployed in remote locations during exploration drilling to quantify the levels of underground hydrogen prior to digging full hydrogen wells. It helps reduce drilling expenses by providing real-time results which decrease the number of full hydrogen wells. This reduction in drilling helps to lower environmental impact.

Prior to the design of this system, drill samples were collected and shipped back to a laboratory to be analyzed. This testing cycle typically takes 1 to 3 weeks to complete. This delay caused critical time loss for the field drilling team waiting for positive results or wasted time drilling exploratory wells in poor locations.

With ADVINT's new system, analysis now happens real-time during the drilling process. This provides the drill site with little or no delay for results and it allows for higher fidelity in testing data as drilling is occurring.

Advanced Mathematics and Filtering with LabVIEW

In the previous laboratory testing method, the data was exported from the test systems and analyzed by hand. LabVIEW offers a wide range of extensive mathematics and filtering libraries. These built-in filtering toolbox functions allow ADVINT to quickly develop complex waveform front-end filtering, which provides clean high-resolution data for analysis. The filtering enables removal of offset background levels, signal noise reduction, and custom tuned notch filtering. The mathematic toolboxes enable rapid development of custom

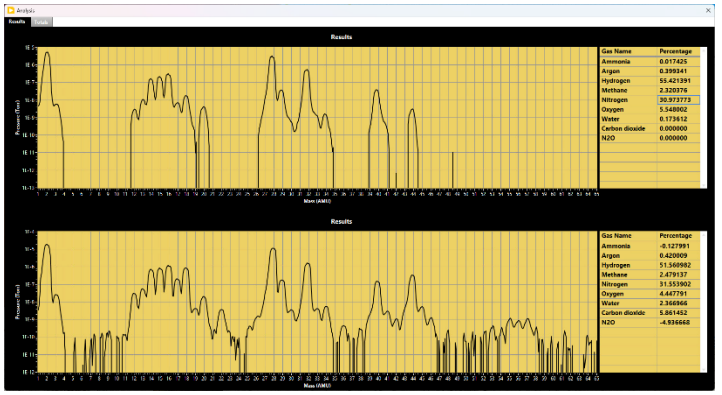

Figure 1: Results Display for the Composition Analysis of the Data

matrix calculations, which are required to solve the multivariable data sets gathered during the gas analysis. These features offset the extensive time required if the filtering and mathematical routines were developed from scratch. By using LabVIEW toolboxes, ADVINT's team had over 200% reduction in development time. By choosing LabVIEW as the software platform, analysis could be performed autonomously on the same system as the data collection. It was the ideal software choice for this high-end scientific analysis system due to development and integration of various communication standards and data collection.

Quick Hardware Integration Times

LabVIEW speeds up the development time of integrating the various high-end scientific detectors and sensors used in the system. Incorporating standard device drivers and ethernet communications, these detectors and sensors are quickly integrated into LabVIEW through custom wrappers and staged into standard process control routines. This allows for maximum flexibility and customization for process control. The temperature control is executed through multiple thermocouples staged around the system. The temperature of the system requires tight control for reliable analysis of the test samples. These low-level signals are measured through NI hardware to collect high quality reliable data. Due to the high sensitivity and complex nature of an analog thermocouple signal, the NI hardware is the right choice with integrated cold-junction compensation. This feature allows the team to take 65% better measurements than sampling signals with a generic analog card.

Leveraging LabVIEW for an Intuitive and Custom User Interface

The system features a custom user interface (UI) developed using LabVIEW, designed to streamline user interactions and improve operational efficiency. By creating tailored graphical controls that visually replicate the system hardware, users can easily relate the software interface to the real-world setup.

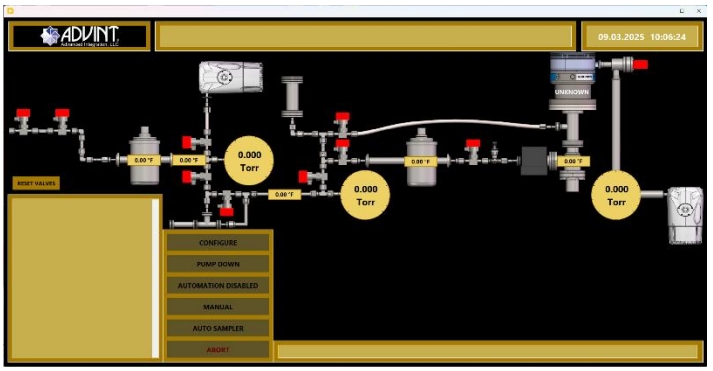

Figure 2: Main Graphical Interface Showing System Status

These custom controls provide clear, real-time system status updates, making it easier for users to monitor and manage operations. LabVIEW's advanced UI capabilities enable the development of a sleek, modern interface that is both intuitive and user-friendly, enhancing the overall user experience.

The user interface also integrates with a wide range of device Application Programming Interfaces (APIs), enabling seamless communication with various hardware components throughout the system. This integration allows operators to run the system autonomously under normal conditions while retaining the flexibility to manually override control when needed, whether for troubleshooting, break/fix scenarios, or when more precise, hands-on operation is required during test procedures.

Conclusion

ADVINT's gas analysis system—built with NI hardware and LabVIEW software—redefines field-based gas extraction and analysis. By combining real-time acquisition, advanced filtering, and intuitive control, the solution empowers energy companies to explore cleaner fuel sources faster, smarter, and more sustainably.

About ADVINT

Located in Columbus, Ohio, ADVINT is a veteran-owned small business and a recognized leader in the design and build of automatic test systems for military and commercial applications. As a full-service system integrator, we provide end-to-end hardware and software development, custom fabrication, and turnkey solutions tailored to the most demanding environments without compromising precision or performance. Our multifaceted platforms integrate advanced data acquisition, control, and analysis capabilities, empowering clients to solve complex challenges in any industry (clean energy, aerospace, defense, life sciences, manufacturing, etc.). Whether you're seeking real-time field diagnostics, intuitive user interfaces, or scalable automation, ADVINT, known for unsurpassed customer responsiveness, supports everything from early-stage consultation to full deployment.

Contact Us

ADVINT
6880 Tussing Road
Reynoldsburg, OH 43068-4101

614-863-2433
www.advint.com

info@advint.com