Distributed DAQ and Reporting System for Hydraulic Spray Nozzles

by

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Category:

Manufacturing Functional Test

Products Used:

FieldPoint™
LabVIEW™ 6.1

The Challenge: To implement a system for collecting data acquired during spraying nozzle tests simultaneously and asynchronously running on multiple stations into a central database. Some of the test stations are mobile while others are stationary. A mobile station can be used on its own, but may also be combined with a fixed station for some types of tests.

The Solution: To develop a control and data acquisition system using National Instruments FieldPoint and LabVIEW. This system monitors and records test results using a PC running LabVIEW via wired and wireless Ethernet to an SQL Server database.

Introduction

Test readings were collected and recorded manually by operators periodically looking at the gauges. This introduced many errors, inconsistencies and unreliable data; proving it necessary to automate the logging procedure. Data retrieval was not accessible from any network computer due to lack of centralized electronic storage.

The customer has eleven test stations, which can run simultaneously and asynchronously, for testing spraying nozzles. Each station has three pressure transducers and a Micromotion flowmeter. In addition to flow, the flowmeter reports temperature and density. Tests can utilize up to two test stations. The test station is responsible for feeding fluid to the nozzle and reading the fluid flow, temperature, density and pressures at three points. When a second station is used, it performs the same functions for air fed to the same nozzle. Any test can be set up and started any time. The parameters are monitored for specified time and recorded at specified intervals. This procedure is repeated for the required number of steps.

System Description

A schematic of the system is shown in Figure 1. The main laboratory computer runs a LabVIEW application which enables the operator(s) to start, view, and stop collection of data from test stations. It connects to the company database server and performs logging of all the test parameters into an SQL Server database. This computer also enables the user with the proper security settings to calibrate test devices, perform system administration, and validate I/O.

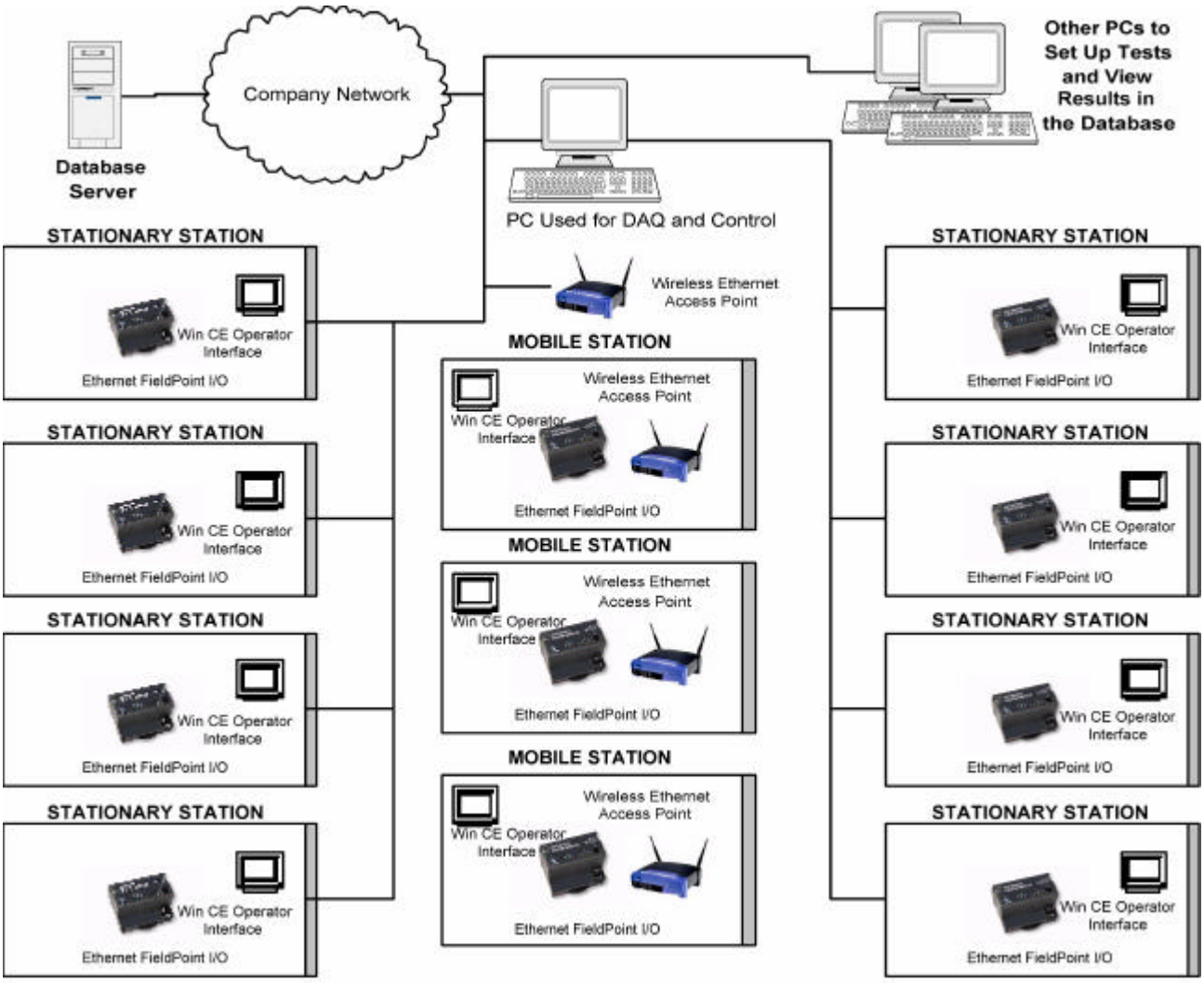

Figure 1: Schematic Representation of the Control and Data Acquisition System for Spraying Nozzle Testing.

Because the test stations are distributed around the laboratory floor (three being mobile), FieldPoint distributed I/O was a natural choice for remote data acquisition. The data acquisition from the stations is accomplished using FieldPoint modules connected to the main PC via an Ethernet network using TCP/IP protocol. The three mobile stations are connected wirelessly via 802.11b, making the connection transparent to the Fieldpoint software. Each station has a bank of FieldPoint modules consisting of an analog input module, a PWM output module, and an Ethernet communications module. The analog input module is wired to the pressure transducers and analog signals from the flowmeter to collect pressure, flow, temperature, and density. The PWM module is connected to a flow control valve. There is a small WinCE based operator interface terminal (OIT) at each station, which is connected to the main computer via Ethernet. This OIT displays current parameters as well as test progress.

Choosing LabVIEW as the development tool for the application allowed easy implementation of a complex program architecture. Multithreading and synchronization tools in LabVIEW made it possible to create the software as a collection of components that have uniform structure, but different purposes. Each component handles a different area of the application's functionality including:

- Hardware resources allocation and management
- User management
- Collection of the data from the FieldPoint I/O
- Individual test logic
- Communication with WinCE OITs
- Writing user name, calibration information and test parameters and results into the database
- Displaying and graphing information on the respective Test User Interface (UI) windows

Each component runs independently providing services to other components and exchanging data via standardized queued messages. Easy access to ActiveX Data Objects (ADO) functionality in LabVIEW ensured seamless integration with the SQL Server database.

All information about users, as well as calibration information for all pressure transducers and flowmeters, is stored in the database. The LabVIEW program provides UI screens to enter, view, and modify setup information. Authorized users have access to FieldPoint I/O addressing information and OIT addresses. The Station Configuration screen allows the user to assign available pressure transducers and flowmeters to stations. The Overview screen provides management with overall information about the system utilization including:

- Number of tests are currently running
- Test owner on each station
- Operator logged into each OIT

After logging into one of the available eleven OIT panels, the operator chooses which station(s) will be used during a test. The chosen station(s) becomes unavailable for selecting on the other OIT panels. All the test parameters are sent to the test computer for each step. After a test has begun, data is collected and displayed on both the OIT panel and the corresponding window on the main PC (Figure 2). This data is also stored into the database. Multiple tests can be set and run by multiple users at different times and the tests typically last for a long time. As a result, the Test UI screens can be closed and opened without interfering with the test logic execution supervised by independent program components for each test.

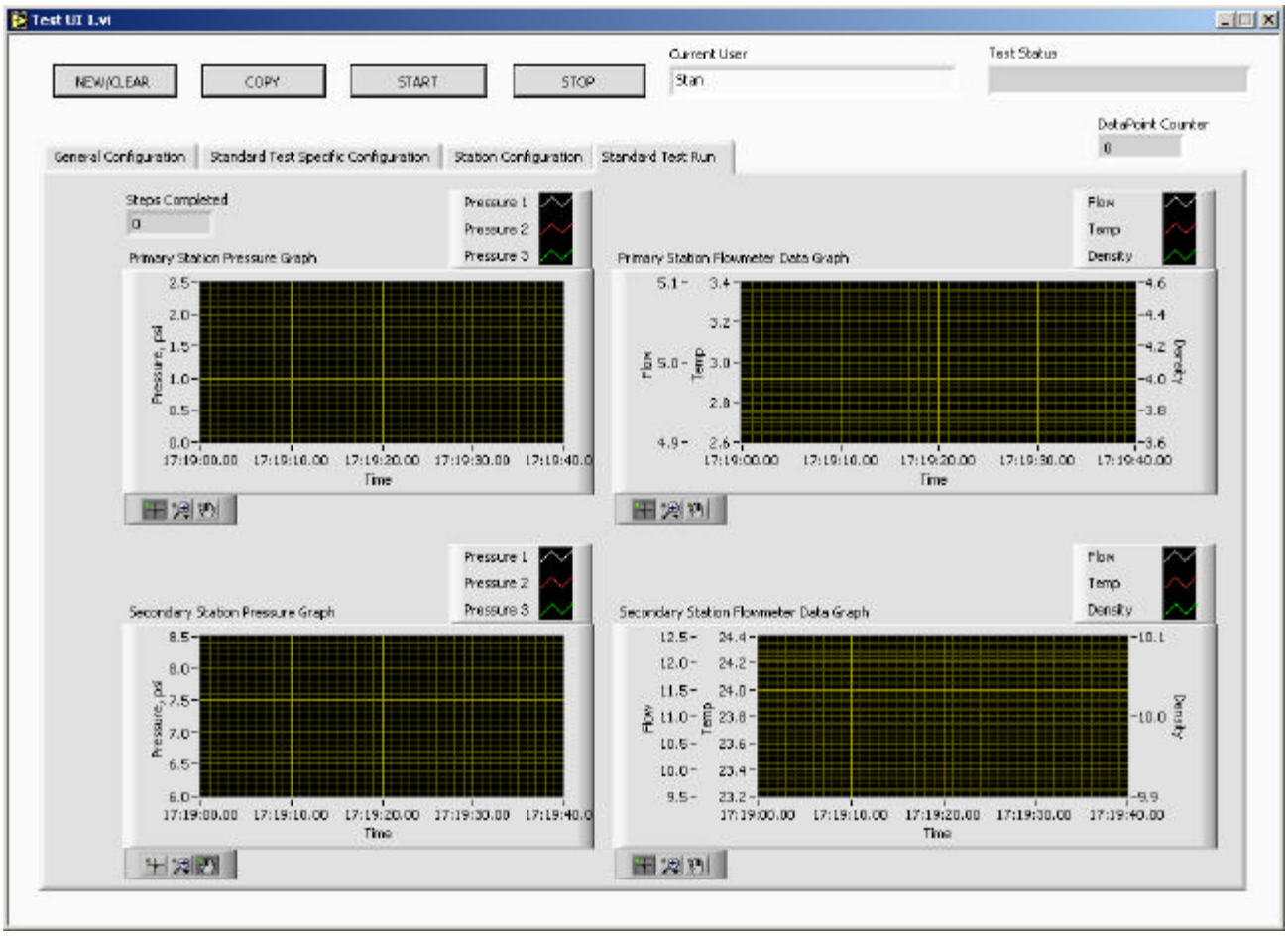

Figure 2: A Test UI Screen in Run Mode.

The Remote Panel feature of LabVIEW allows UI screens to be accessed over the Web from multiple computers. This allows several operators to simultaneously set up and run tests from computers other than the main PC.

System Benefits and Conclusion

FieldPoint and LabVIEW made it possible to quickly create a fully automated control and data acquisition system allowing flexibility that boosted productivity and decreased the cost of spraying nozzle testing. Central storage of data allows secure storage and retrieval via a variety of methods. The accuracy of the data will now allow for much better information for management to monitor and analyze. This new reliability will allow for process improvements that were not previously possible.