Acquiring Data from Multiple Asynchronous Processes on a Single DAQ Card
or
Stretching Your DAQ Dollar

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Category:
Production Test

Products Used:
LabVIEW
PCI-6025 Multifunction Card

The Challenge: A leading biomedical manufacturer desired a system for monitoring 2 to 4 dielectric heat sealers from a single computer, preferably using a single data acquisition card. A unique triggering mode had to be developed to allow acquisition from each sealer to proceed independently of the operation of the other sealers.

The Solution: A form of software triggering was developed that utilized continuous, buffered data acquisition in a LabVIEW program, with software determination of when an individual sealer was active.

Abstract
Although National Instruments' Daq boards are very versatile and can be triggered in numerous ways, one situation they do not readily address is acquiring data from several asynchronous processes on different channels of the same card. In order to monitor four independent dielectric heat sealers with a single Daq card, a form of software triggering was developed which was implemented within LabVIEW rather than in the NI-Daq driver. All the analog channels are continuously acquired using buffered analog input. The program scans each machine's channels and accumulates events from each machine as they occur.

Monitoring Multiple Sealers
At the manufacturer's plant, numerous dielectric heat sealers are used on the production floor for making vinyl bags. Numerous faults can cause failures in the final product, including operator error in material feed, incorrect setting of machine controls, or malfunction of the equipment. In an effort to insure the quality and consistency of the product, a study was made of the RF currents used in the sealing process. It was found that each of the common failure modes produced signatures in the current signals. Therefore, it was determined that a data acquisition program should be written to monitor the production process so as to automatically identify faulty products, thereby increasing quality and decreasing post-production testing.

In order to analyze the production process, a plate current and a grid current signal needed to be acquired for each machine cycle. Since the sealers are triggered manually by the operators, these signals, which are about six seconds long, occur at random intervals on the order of a few minutes. The sealers also put out a digital pulse coincident with the current signals. The most obvious architecture for a data acquisition program monitoring one of these machines would therefore be to use hardware triggered waveform acquisition. However, with a low channel count per machine and numerous machines to monitor, a more versatile solution was desired which would allow a single computer to monitor several asynchronous sealers. Unfortunately, multiple hardware triggers cannot be used on a single Daq card.

In order to overcome this limitation without the expense of buying multiple Daq cards, a form of software triggering was implemented. One form of software triggering is available directly in the NI-Daq driver software. In this mode, the NI-Daq driver software continuously acquires data from the Daq board and analyzes the data to determine if specified triggering conditions have been met. Once those conditions are found, the driver supplies the relevant data to the calling software.

Custom Software Triggering

For the dielectric heat sealers monitor, a more complex form of software triggering was required, which necessitated it being written within the LabVIEW program. To accomplish this, each sealer's digital output was connected to another analog input of the Daq card, giving a total of three channels per sealer, or twelve channels for monitoring four sealers. Standard continuous buffered analog input was then used (as shown in Figure 1), with all twelve channels continuously being acquired at a rate of 1.5 KHz and a buffer cycle of 5 Hz. During each 200 ms cycle, the trigger channel for each sealer was examined using the Threshold Array function to determine if an event had started. If an event was found, the plate and grid current data was collected starting at a point corresponding to the leading edge of the trigger signal. Data were then appended to these arrays for over 30 additional cycles until the full signals were acquired. The pass/fail algorithm was then applied to these signals, and any failures were automatically logged. In addition, the pass/fail status is displayed on the front panel and is supplied to digital output for feedback to each machine.

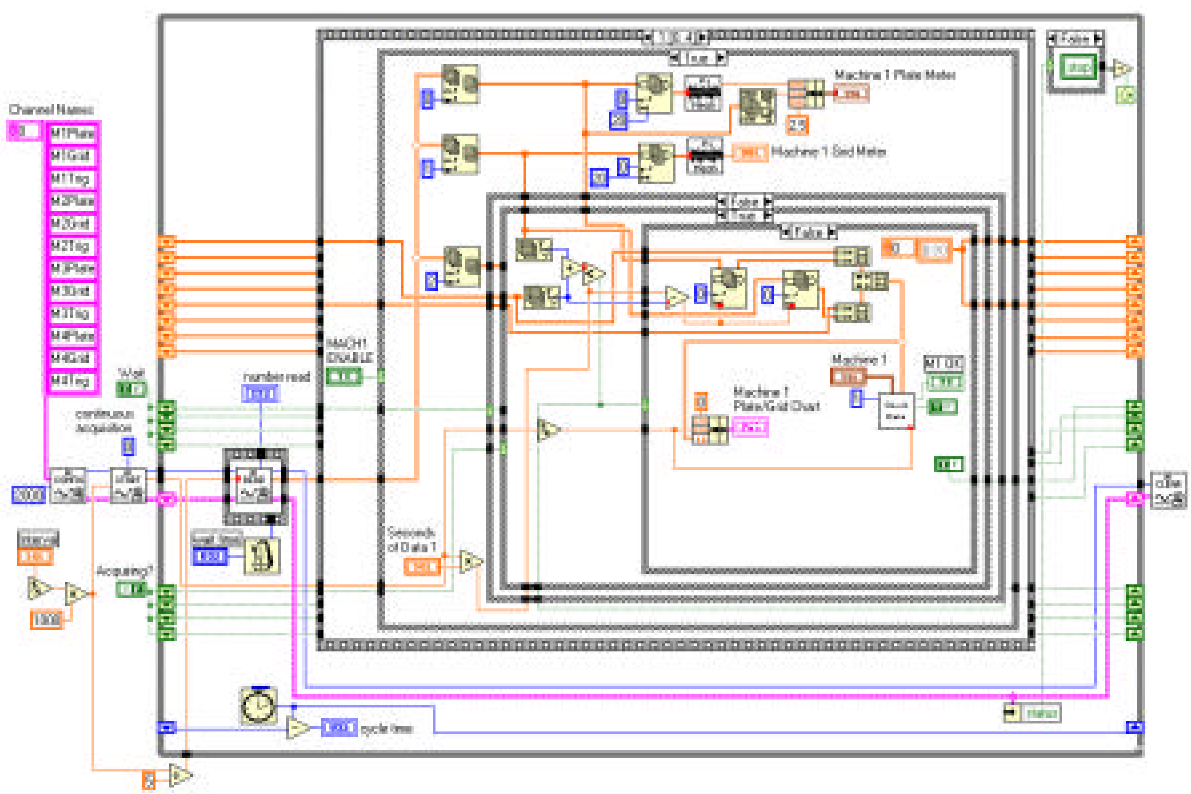

Figure 1. The data acquisition loop. Note that the User Interface loop, which runs in parallel with the data acquisition loop, is not shown. The upper eight shift registers are used to accumulate the two current signals for each of the four machines over numerous loop cycles. The nested case structures control the logic for detecting an event, accumulating the signals, and running the pass/fail algorithm on a complete event.

Using this architecture, data from up to four sealers could be acquired using a single data acquisition card. This method automatically allows for events from multiple sealers that overlap in time to be analyzed with no loss of data. Another advantage of this architecture is that continuous acquisition of the current signals at a 5 Hz rate allowed the near-real-time display of these current signals on familiar-looking panel meters in the LabVIEW window, as seen in Figure 2. These meters closely resemble the current meters found on the sealers themselves, and so provide cycle status for engineering and remote monitoring.

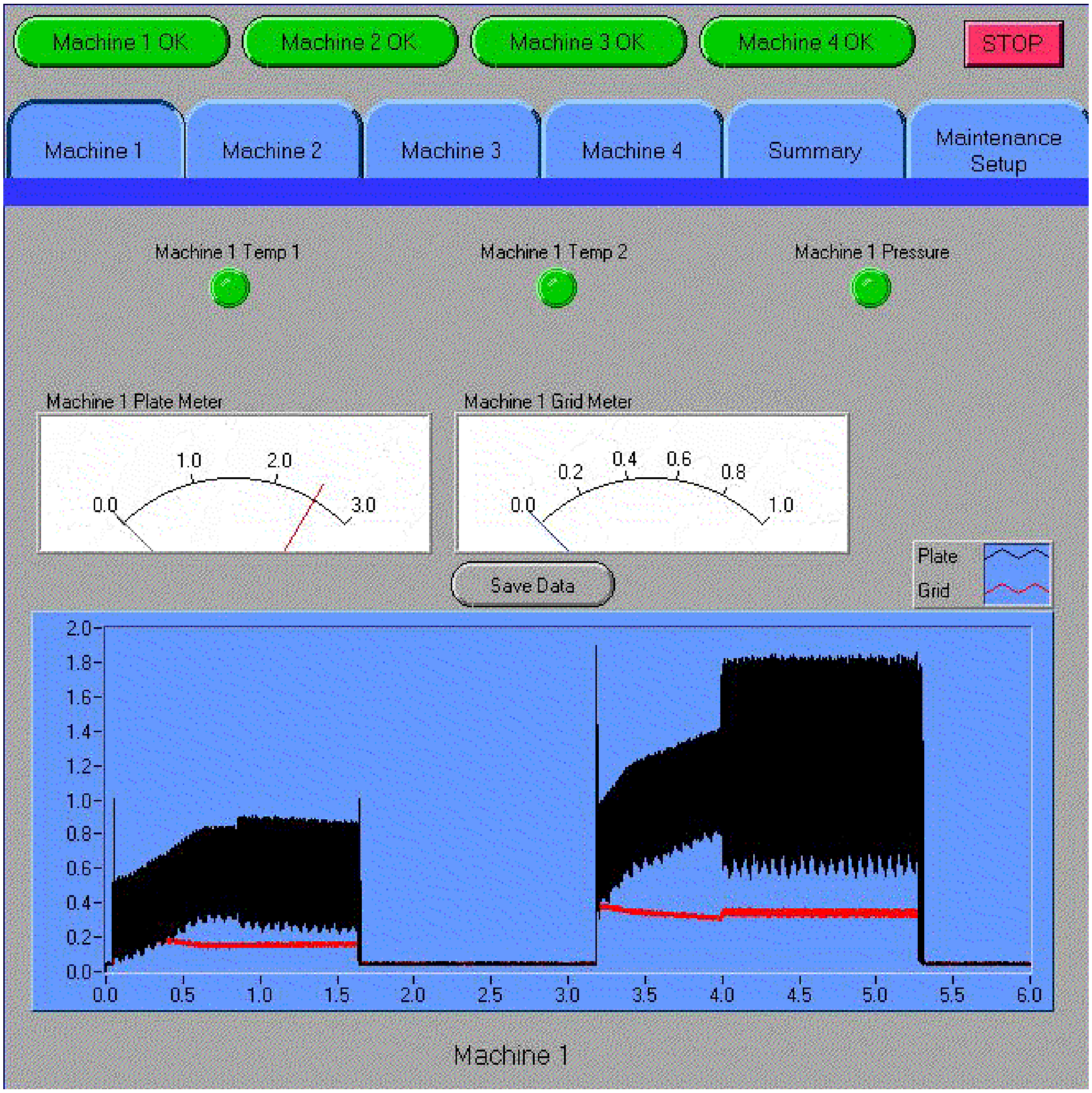

Figure 2. The front panel of the Sealer Monitor program. Pass/Fail indicators for all four machines are always visible at the top of the screen. The row of buttons below those indicators allow the operator to choose which machine to monitor in more detail. Two other buttons bring up a summary of pass/fail results for all machines and a configuration screen.

Additional features were added to this program to increase its usefulness. A password-protected maintenance screen ensures that the machines are operated with parameter values that have previously been validated. Automatic logging of product failures with descriptive explanations and the option of automatically saving the current signals allow for post-production analysis of failure modes. Also, remote access to the program was provided by enabling the Web Server functions built into LabVIEW 5.1, allowing a supervisor to remotely monitor the program and all four machines' operation.

The program developed for the biomedical manufacturer promises to provide an economical means of automating product testing. This should increase the quality of the product as well as reduce its cost. The efficiency of developing software within LabVIEW, combined with the versatility of this programming language, allowed for a very cost-effective solution to be implemented.