



# Exciting Uses of National Instrument's cRIO Platform

James Campbell—President, Viewpoint Systems

## Introduction

The Compact Reconfigurable I/O (cRIO) platform from National Instruments has allowed Viewpoint Systems to broaden the scope of potential applications we can tackle for our customers. In this article, I will discuss a series of challenges Viewpoint Systems has successfully solved for our clients with the cRIO platform. Project detail has been eliminated to protect proprietary information, and to allow us to focus exclusively on the cRIO's usage in three different scenarios: instrumentation, embedded, and acting as a fast controller.

## Background

The cRIO platform combines a controller with I/O modules for data acquisition and control. The controller is based on a Pentium-class processor.

All the I/O modules are accessed through the FPGA which is tied into the embedded backplane. The FPGA can be programmed with LabVIEW to perform numerical analysis and decision making at up to 25 ns per cycle. The FPGA code communicates with the host processor for configuration and data I/O.

## Applications

- **Instrumentation**

The first application illustrates the cRIO as a custom signal conditioner. The heart of the application entails acquiring signals from an LVDT sensor to measure position. The application works by relying on the idea that the ratio of the response and stimulus signals gives a measure of the LVDT position. The ratio computation is known as the "demod" process, since it involves demodulating the LVDT AC signals.

Instrumentation products are available to output an analog demod signal. However we wanted to build a custom instrument with the cRIO to reduce noise beyond what was capable with an off the shelf analog solution. Our cRIO "instrument" did not need an analog output since we had the demod numeric value from the FPGA. We were able to tradeoff

noise and response by changing the digital filter in the FPGA.

The main challenge was the digital filtering design, which simultaneously demodulated the AC while removing noise. NI's Digital Filter Design toolkit was critical for the integer math required on the FPGA.

The final results produced by the cRIO have been fantastic, exceeding all expectations.

- **Embedded**

The second application we explore utilizes the cRIO as an embedded device. In this instance a large machine is instrumented with a sensor useful for monitoring performance of the machine. Historically, the sensor readings were used annually for maintenance checks.

Today, continuous predictive monitoring is common and our customer desired this capability for their machine. A difficulty arose in this project because the sensor signal is very complex and requires analysis to extract the meaningful information.

In our solution, the FPGA collects and pre-processes the data and the cRIO processor supplies the floating-point numerical horsepower. A touch screen panel interfaces with the cRIO controller to display and interact with the results.

An enclosure completes the embedded device. The device resides permanently next to the machine and give instantaneous feedback on performance. Ethernet networking from the cRIO allows remote connections.

- **Fast Controller**

The last application examines the cRIO as a controller to manage production of glass containers. The containers are produced about once every 200 ms.

Three inspection sensors along the production path detect bad product. The location of these sensors are far away from the reject actuator. If any of the sensors show a defect for a given container, the container must be rejected. Three pass/fail FIFOs with appropriate shifts are managed and

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All classes are held at Viewpoint's Certified Training Center in Rochester.



To register go to [www.ni.com/training](http://www.ni.com/training) or call 585-475-9555.

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OR'd together at the reject station. A major challenge was the need to offset the reject signal by a few ms. The reject hammer performance degrades unless it hits the containers dead-on. The FPGA handles this timing with less than 25 ns of jitter. A software adjustment tunes this delay for optimal response. This application would be hard to do using a PC, using the FPGA makes it straightforward.

### Summary

These three applications show the breadth of capability provided by the cRIO and FPGA combination. The small form-factor and ruggedness make cRIO an ideal solution for places that a PC would not fit. Plus, we have found the incredibly small real-time jitter and the hardware level programming in the FPGA actually can make some tasks simpler than a PC with DAQ hardware. Give us a call if you would like more details.

## Viewpoint News Your Informational Resource

### Website Redesign in Progress!

We have been working hard on updating our website. The pages are being reorganized to allow easier information and we are adding a lot more content about our capabilities, personnel, and ways we can improve your productivity and profitability.

We are scheduled to go live by near the end of August. We may have gone live since you started reading this article. Check it out, you won't be disappointed.

And of course we invite you to send us your feedback!

# Tips and Techniques: UTC and LabVIEW

Benjamin Hysell—Systems Engineer, Viewpoint Systems

LabVIEW 6.1 and up all versions

Problem – Collecting data files in multiple time zones and coordinating what time those data files were collected can be a demanding task. Consider this: I have test stands that produce data files that imbed the date and time of when the file was collected into the header of the file. Being a large company I have multiple test stands all over the country, several in NY and even more in CA. Collecting data in NY and then looking for that data by date and time in NY is easy enough, if the files are listed by date and time all I need to do is remember when I collected the data and find the appropriate file. If I choose to look at a CA data file I have to remember to subtract three hours from every file. Not too difficult of a task, however things quickly get thorny if I fly to CA, collect a couple of files, fly back to NY to analyze them, and I'm trying to find the file I collected around lunch time. Do I look for the file around NY lunch time or CA lunch time? Now throw in files collected in Belgium, Japan, Brazil, and one can see how the problem becomes increasing complex.

We need to use on consistent time zone across all of our data files, and this is where UTC comes into play. UTC is defined by Wikipedia as a standard time where each time zone is represented as an offset in hours, plus or minus from Greenwich Mean Time. ([http://en.wikipedia.org/wiki/Coordinated\\_Universal\\_Time](http://en.wikipedia.org/wiki/Coordinated_Universal_Time)) If we keep all of our dates and times in UTC it won't matter where we collect the data files, when we try to find them, the time reported will have a consistent time zone from computer to computer.

LabVIEW's "Get Date/Time in Seconds.vi" returns a time zone independent number of seconds from 1/1/1904 at 12am. Using this VI, we can return a UTC seconds since 1904 value and place it in our headers. This number is great for the computer, (5/29/06 returns 3231795461.74), however for us trying to use and read the number it is very difficult.

To break this number into seconds, minutes, hours, etc. we often use "Seconds to Date/Time.vi". Close reading of the online help for "Seconds to Date/Time.vi" will reveal it takes seconds since 1/1/1904 and returns a cluster broken into seconds, minutes, hours, etc. The twist: every time this VI is used it applies the time zone offset of the local computer to the time. We effectively convert the seconds since UTC to a date/time in our current locale. However, in this application, what we really want is seconds since UTC to be converted to seconds, minutes, hours, etc. in UTC. The following block diagram in Figure 1 of my UTC.vi does just that.

The first thing we are doing in this block diagram is asking the computer for its "ActiveTimeBias" registry key. This key, stored in the registry, tells us the current time difference between us and UTC in minutes. A full explanation of this registry value can be found at <http://www.windowsitpro.com/Article/ArticleID/14966/14966.html>. Using the value returned from the registry, we can convert it to seconds, and add the result to the value returned by "Get Date/Time in Seconds.vi".

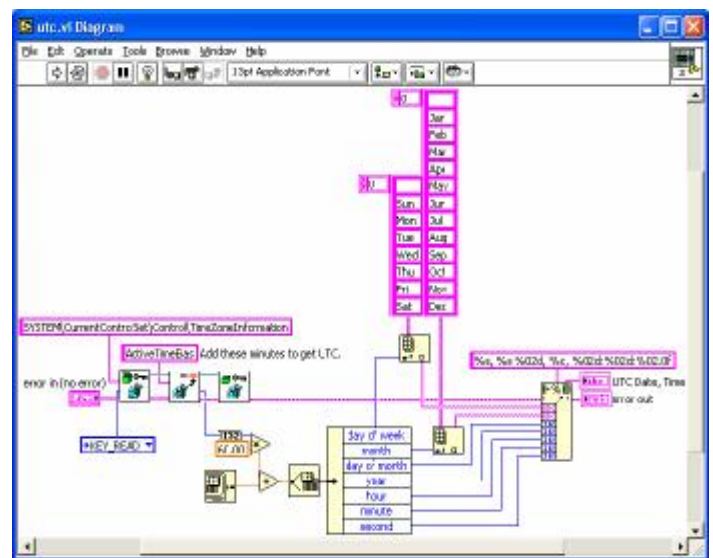


Figure 1. Block Diagram of UTC.vi

We then take the result and wire it into "Seconds to Date/Time.vi" and the result will be a cluster of seconds, minutes, hours, etc. in the UTC time zone and not the local computer's time zone. What we have effectively done is to apply an offset to the value returned by "Get Date/Time in Seconds.vi" and then immediately removed the offset in the "Seconds to Date/Time.vi". The remainder of the code is used to convert the cluster to a text string for easy viewing.

Build the above LabVIEW vi and try changing time zone on your local computer and see the results.

## Questions and Comments

Please email us at [newsletter@ViewpointUSA.com](mailto:newsletter@ViewpointUSA.com). We welcome your input as we grow Tips and Techniques.

## LabVIEW Code Challenge

Do you think you have what it takes? Apparently, no one does as not a soul stepped up to the challenge from our last issue. View last issues challenge, the solution, and meet Scott Blackwell the Viewpoint engineer who took up the challenge at [www.ViewpointUsa.com/CodeChallenge/spring2006.asp](http://www.ViewpointUsa.com/CodeChallenge/spring2006.asp)

Use LabVIEW to solve this issue's challenge:

**Your bank account has a beginning balance of \$10,000. Interest is compounded monthly at 6% per year (0.5% per month). Every month, \$500 is withdrawn for rent. How many years will it take to deplete your bank account?**

Read submission rules at:

[www.ViewpointUsa.com/CodeChallenge/summer2006.asp](http://www.ViewpointUsa.com/CodeChallenge/summer2006.asp). Our prize gift certificate has doubled to \$100 and will be awarded to the winner prior to publication of our next issue.

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Engineered to Work.*

## Notes from the Editor:

Welcome to another exciting issue of the Viewpoint News! Summer is finally here in Upstate New York...people are gearing up for family vacations and everyone around the office is excited about Viewpoint System's summer picnic. This year we are all invited to a local amusement park for a day with our families. I'm personally looking forward to a fun-filled day of relaxing with my co-workers and the partners, as we unwind and step back from our respective projects. Here is hoping for good weather!

Inside this issue:

**Title Story**—Several applications are described that use NI's cRIO and FPGA platform.

**National Instruments Training Schedule**—Check out upcoming classes taught in our beautiful training facility right here in Rochester.

**Tips and Techniques**—Getting a universal time textually out of LabVIEW can be a difficult task. This issue we explore one method to do so.

**LabVIEW Code Challenge**—Do you have what it takes? Sadly no one did last issue. Our gift certificate has doubled for this issue, so step up and claim a \$100 gift certificate.

As always, we are constantly looking for the next great challenge and we look forward to partnering with you to conquer it.

-ben  
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