CompactPCI: NOT JUST FOR TELCO

While CompactPCI has been embraced by the telcos, it has also found a home in a variety of other industries. The following application stories provide insight into three very different places you'll find CompactPCI / PXI in use today:

- **Display wall controller for control room applications**
- **Load weighing system for trucking**
- **Automotive testing of cam-position sensors**

Display wall controller for control room applications

By John Stark

Jupiter Systems has used CompactPCI technology to create a unique display wall controller which meets its customer's reliability, flexibility, and ease of use requirements, while delivering high-performance graphics to as many as 124 monitors or projectors simultaneously.

The Jupiter 870 series controller utilizes a 6U CompactPCI backplane coupled with a dual Pentium III-based motherboard with built-in dual 10/100 Mbits/sec Ethernet devices and an I/O module that contains:

- One SCSI fixed disk
- 1.44-inch floppy
- 40x CDROM drive
- Standard serial, parallel, and USB ports

There are seven available CompactPCI slots for expansion peripheral devices. Each CompactPCI expansion slot typically contains a Jupiter proprietary graphics card providing up to four output graphics channels and four video input channels. With this high output channel density, a single chassis can drive up to 28 individual monitors or projectors. Using CompactPCI expansion cabinets, up to 124 output display channels and up to 32 video inputs are possible. Graphics output resolutions (per channel) of 640x480 to 1600x1200, and color depths of 8, 16, and 24 bpp are possible.

High performance Microsoft Windows NT 4.0 and Red Hat Linux display drivers virtualize the output of the graphics cards to create a single logical screen from multiple outputs. Application windows can be moved and resized freely over the entire array of output devices, and large numbers of application windows can be opened simultaneously without overlap. Overall resolution is the accumulation of each output. For example, with a 12-channel display system configured in a 4x3 (4 wide, 3 high) array with each channel output being set to 1280x1024 pixels, the overall desktop resolution would be 5120x3072 pixels.

Display of full frame rate NTSC or PAL video is possible with included Jupiter software. Video windows can be moved and resized freely over the entire desktop surface; built-in scaling engines allow video to be resized up to that of the entire display. Video windows can be "grabbed" and saved to disk for later use.

Display wall controllers have become a critical component in control rooms for industries such as:

- Process control
- Telecommunications
- Transportation
- Public utilities

Higher reliability, greater performance, and the promise of little or no downtime are prime drivers of the purchasing decision. To meet these needs, graphics cards are hot swappable, and can be removed while the unit is in operation. In addition to hot-swappable graphics cards, the 870 series includes hot-swap redundant power supplies and hot-swappable fan assemblies. The rear I/O panels are separate from the front-loaded CompactPCI slots, allowing the removal of hot-swap devices without touching the cabling at the back of the unit. This can dramatically reduce MTTR, and is simple enough that anyone, not only trained technicians, can perform the operation.

For further information on this article or Jupiter products, contact:

John Stark, Director of Marketing
Jupiter Systems
3073 Teagarden St. • San Leandro, CA 94577 • Tel: 510-667-9000

CompactPCI-based load weighing system helps mine operators control transportation costs

By Irvin Miller

The giant trucks that haul ore from open mine pits to processing plants are among the world's costliest machinery to maintain. And, the largest single factor affecting their cost-effective performance is their load: too heavy, and maintenance costs soar; too light, and productivity falls like a rock.

Until recently, the accepted method of gauging a mine truck's payload was to weigh the whole thing, load and all, then subtract the weight of the empty truck from the total. The whole process was pretty crude, and certainly not very accurate. Clearly, mine operators needed a solution that would provide accurate payload weight yet sustain rigorous application requirements typically found in their industry.

To meet these unique requirements, a leading manufacturer of mining equipment has developed a computerized weighing system based on the CompactPCI and VME processors supplied by PEP Modular Computers. The new shovel-mounted system weighs loads with an accuracy of ± 2% before they are emptied into the haul truck. A dynamic bar graph display changes colors as the accumulated truckload weight approaches a preset target, providing the operator with real-time, visual payload data.

In designing the system, ruggedness of the Eurocard format was essential to address the high reliability requirements of the application. Because of limited space availability, the small size of the 3U system was also a critical advantage.

The heart of the load weight control system is a two-part computer with a real-time portion and a user interface portion. The real-time portion consists of a VMEbus system containing a PEP VM42 68040 based processor, and various I/O boards. This system collects data from sensors located out in the shovel's bucket, and reports its results to the user-interface.

The user-interface portion incorporates PEP's CP312 Pentium-based processor, and I/O boards packaged into a CP ASM-4 chassis with CompactPCI backplane also produced by PEP Modular Computers, Inc. Windows NT was selected as the operating system because of the wide availability of software, graphics support, and broad acceptance in the marketplace. The user interface portion of the system displays the data collected by the real-time portion. Both elements are housed in a single 19-inch 3U enclosure that fits snugly into the shovel operator's cab. Separate power supplies are provided for each, and they communicate with each other via Ethernet using a PEP CP340 Ethernet controller. This allows them to function independently of each other. If one side needs to shut down for maintenance, it will not effect the operation of the other part of the system. The real-time portion is supported by VxWorks® software — chosen for its real-time performance, ease of programming, and availability of I/O drivers. The User Interface portion is running Windows NT to provide a user-friendly and graphical interface.

The end result is a programmable, load-weighing system that mine managers can rely on to optimize their transportation equipment performance. Real-time computation of loading data makes it easier for operators to ensure consistency and accuracy with truck payloads. A touchscreen enables them to easily factor in variables such as:

- Haul distance
- Material density
- Weather
- Road conditions
- Fragmentation size
- Blasting efficiency
- Truck capacity
- Voids

With these factors in place, it's a relatively simple computing job to determine just what the consistently optimum load should be for each individual truck, in each individual mine.

The load weight control system is also an asset to mine operators with automated truck dispatch systems. It enables them to match haul trucks from mixed fleets to separate excavation sites for their most efficient usage. The load weighing system is already in use in the United States and Canada.

Irvin Miller, *Central Regional Manager for PEP Modular Computers, has over 20 years in the computer industry. He holds a BS in Electrical and Computer Engineering from the University of Wisconsin-Madison, as well as an MBA from Edgewood College.*

For more information contact:
PEP Modular Computers
750 Holiday Dr, Bldg 9
Pittsburgh, PA 15220
Tel: 800-228-1737
Email: info@pepusa.com
Website: www.pep.com

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PXI-Based Test System Performs Production Testing of Cam-Position Sensors

By Gary Sweezy and Jackie Batson

Invensys Corp. manufactures cam-position sensors that are used in diesel engines to provide feedback on piston position. This feedback is used to provide real-time optimization of engine firing and burn, hence, improving fuel efficiency.

The sensor, a high precision, hall-effect sensor, outputs an analog pulse train that corresponds to the transition pattern of a target disk mounted on the engine cam gear. The target pattern consists of metal/air transitions that determine piston position throughout each engine stroke. The output voltage and transition ratio of each sensor must be tested thoroughly to ensure that it meets or exceeds acceptable quality and performance standards.

Invensys contracted MicroCraft Corp., a National Instruments Select Integrator, to design and build a test system. MicroCraft chose to use LabVIEW in conjunction with off-the-shelf National Instruments hardware to provide a maintainable and configurable system capable of changing with expanding needs.

System architecture

MicroCraft began by selecting a National Instruments PXI industrial computer running Windows NT to provide a friendly and robust operating platform. Next, we added a National Instruments PXI-5102 digital oscilloscope module for capturing the UUT waveform. We selected the PXI-5102 because it offered a reliable means for high-speed waveform capture at about half the cost of most digitizing oscilloscopes. In addition, the readily available instrument drivers allowed MicroCraft to quickly develop the data acquisition algorithm without the need for designing and writing complicated counter timer processes.

For proper inspection, the sensor output must be analyzed at varying engine RPMs and air gap settings. The air gap setting represents the sensor's position in reference to the target. An increase in the air gap causes signal intensity to diminish, as does an increase in RPMs. A stepper motor controlling a linear slide adjusts the air gap by positioning the cam sensor in relation to the target. A servo motor turns the cam gear to control RPMs. MicroCraft selected a Compumotor two-axis motor controller to control both the stepper and servo motors.

In addition to RPM and air gap setting, the test unit's output voltage is influenced by changes in reference and supply voltages. These two voltages are configurable via two GPIB-programmable power supplies controlled through the built-in IEEE 488.2 interface on the PXI industrial computer.

A PXI-2565 SPST switch card pneumatically controls the mechanical actuation of the test fixture (UUT positioning, safety guards, etc.). The PXI-2565 optically isolates all output to decrease the noise distortion and feedback prominent in many motion control applications. A PXI-3508 96-channel digital I/O card monitors digital safety limits and feedback. Because isolation is critical, we use optically isolated, solid-state relay modules.

System software

The test software is written in National Instruments' LabVIEW. The main panel of the LabVIEW graphical user interface is shown in Figure 1. MicroCraft and Invensys chose LabVIEW in an effort to decrease development time and simplify maintainability of the source code.

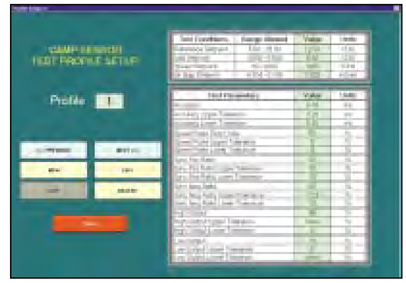

Figure 1

MicroCraft began writing the software well before completion of the mechanical fixture. The modular VI / SubVI architecture of LabVIEW allowed us to test and debug code quickly and efficiently while the LabVIEW data acquisition VIs and instrument drivers shaved several weeks off our development time. In addition, the powerful graphical user interface of LabVIEW allowed us to develop a configurable and versatile program for test engineers and an intuitive, easy-to-operate user interface for system operators. Features of the program include:

- Diagnostic mode
- Multi-level security
- Production statistics
- Run-time menus
- Calibration utilities
- Data logging
- Configurable test sequencing and profile generation

Multilevel access allows test engineers to easily create, adjust, and store test profiles from the profile interface shown in Figure 2.

Operation

After manual loading, the part is automatically positioned and inspected using fiber optic proximity sensors for unit accessories that include an o-ring and mounting bracket. Next, the electrical output is tested by acquiring and analyzing the sensor output with the PXI-5120 digital oscilloscope at user-specified combinations of RPM, air gap, and voltage settings. Acquisition is post triggered by the servo encoder to capture exactly one revolution of the target at each setting. The acquired pulse train is verified for transitions, voltage level, duty cycle, and sync ratios. Passed units are automatically date stamped and each unit deposited in a bin according to its pass/fail status.

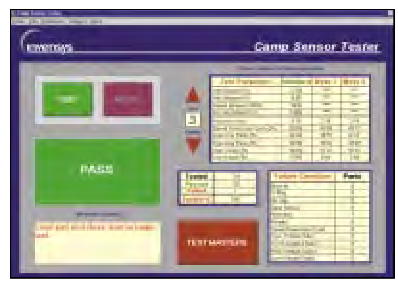

Figure 2

The front panel prominently displays unit test data and statistical information for the current production run. Data for each day's production is stored in an ASCII data log file and can be imported to other applications for statistical analysis.

Multi-level access allows test engineers to easily modify test parameters and design custom tests within the software. In addition, standard initialization files allow custom test profiles to be saved and automatically loaded for future use. Finally, diagnostic and calibration utilities allow quick and easy troubleshooting and calibration of system hardware.

For more information, contact: **MicroCraft Corp.**
3209-154 Gresham Lake Rd. • Raleigh, NC 27615
Tel: (919) 872-2272 • Fax: (919) 872-5822
Email: kellie.hutchinson@microcraftcorp.com
Website: www.microcraftcorp.com