PC/104 intelligent data acquisition

By Jim Blazer

No doubt about it, PC/104 has become the darling of the embedded control market. PC/104 CPUs running Microsoft's MS-DOS or Windows are easy to program and include standard peripherals that are difficult to provide on embedded microcomputers. In this article, Jim discusses the implications for intelligent data acquisition.

A wide array of I/O interfaces are common peripherals in an embedded system, including:

- video
- mass storage
- keyboards
- networking
- serial communications
- parallel I/O
- data acquisition

Special adaptations for embedded control such as watchdog timers, non-volatile configuration and onboard solid state disks make these systems ideal for standalone or networked applications.

PC/104's mechanically rugged design is well-suited to the high shock and vibration experienced in many embedded applications. PC/104 is becoming an increasingly popular choice in applications previously reserved for microcontrollers, for example:

- distributed data acquisition
- industrial control
- communications nodes

It is only natural that PC/104 will be used for data acquisition. How will PC/104 and PC/104-*Plus* change data acquisition? Will the concept continue where many A/D boards feed data directly to the host CPU for processing?

Data acquisition

The engine of change in computer-based data acquisition is the emergence of *distributed intelligence*, which tries to bring intelligence closer to the places where data

is acquired and real-time signal processing is needed. Following this principle, the Intelligent Data Acquisition Node (IDAN) developed by Real Time Devices USA, one of the founders of the PC/104 Consortium, embraces a single concept: the effort to increase system performance by sharing tasks optimally between the different signal processing units.

As an implementation of distributed intelligence, an IDAN can be widely used in:

- adaptive signal processing
- condition based maintenance
- process control

PC/104 and PC/104-*Plus* provide specifications that are well-suited to embedded data acquisition in a distributed intelligence system. By placing intelligence in remotely located "nodes," the data can be collected and processed, and only the results are transferred to the host via a network using a fieldbus such as CAN, Ethernet or simple serial with RS-232/422/485. You can see a graphic illustration of this hierarchical architecture using multiple Intelligent Data Acquisition Nodes in Figure 1.

Intelligent Data Acquisition Node (IDAN)

PC/104 gives system designers the ability to provide data acquisition systems with distributed intelligence and communications, dividing tasks in a hierarchical manner and using the appropriate processing power for each task. Flexibility is one of the key advantages inherent with PC/104: the exact configuration of each node can be adapted to suit the sensors as well as the processing requirements at that location. Furthermore, keeping the processing core near the signals prevents the signal degradation that can be experienced when high impedance analog signals must be sent a great distance to a central computer.

The missing component in this attractive picture has been an enclosure that retains the modularity of PC/104 while it fulfills the environmental requirements of aerospace and industrial applications. The enclosure developed by Real Time Devices, shown in Figure 2, was designed specifically to meet these requirements.

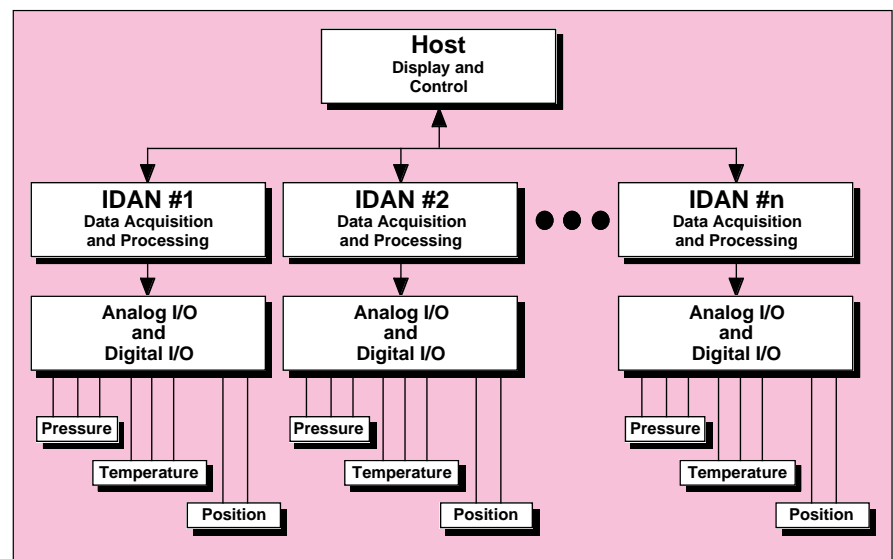Each board in IDAN is attached to a milled aluminum frame that contains all

Figure 1

Figure 2

the board I/Os. Boards can be inserted or removed from the system by simply adding or subtracting frames. When reconfiguring the system, IDAN does not have to be disassembled or rewired, and can be restacked at will.

A minimum IDAN would consist of a CPU, data acquisition board and a power supply. Many systems would include other interfaces such as:

- display controllers
- communication interfaces
- mass storage
- signal conditioning boards

IDAN's modularity allows the system designer to customize the system now, as well as to expand functionality later, by simply inserting new boards with frames. Display controllers for CRTs or flat panels provide a factory floor display for operator intervention. Communications interfaces (serial, Ethernet, or fieldbus) provide networking to intelligent sensors or to a central host computer in a hierarchical architecture.

Data is collected and can be kept locally in mass storage and downloaded to the host only as required. Signal-conditioning, front-end boards, and input modules interface to various sensors. Since they are located near the signal source, they prevent signal degradation.

The CPU can be scaled from a simple, low-power PC/104 XT CPU to Intel's latest technology on PC/104-*Plus*. The critical key is to place data processing and local control where the data is acquired, and only transfer required data and results to the host.

Internet data acquisition

Many operating system developers are incorporating embedded web servers in their software. This software technology, coupled with a properly configured IDAN, provides an entirely new way to perform remote data acquisition. Worldwide access to your data acquisition system using the Internet is a low-cost alternative to dedicated hardwired systems or slow modem connections.

Automated weather stations for ski slopes and vacation resorts are obvious applications; however, industrial alarm systems that can alert you at home, and automation systems that are accessible anywhere in the world can now become a reality.

See for yourself how this technology could work for you. An example using Real Time Devices' PC/104 cpuModule and Phar Lap Software's embedded web server software is available online at http://smallest.pharlap.com.

This website not only shows the current temperature, wind speed, and wind direction in Cambridge, Massachusetts; but it also provides a debug interface to the processes and memory on the CPU.

Implications for the future

The scaleable nature of IDAN allows the user to select the appropriate processing engine and peripherals for each distributed task. As the variety of PC/104 modules continues to expand, so will the market penetration and the overall interest in PC/104 technology. In all probability, "Classic PC/104" will dominate the embedded data acquisition and control markets, with only a gradual yielding to PC/104-*Plus*. PC/104-*Plus* will find its real niche when IDAN applications require frame grabbers, video controllers, high-speed storage, and data acquisition.

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