Atmospheric Research
using the DaqBook®

Avionics

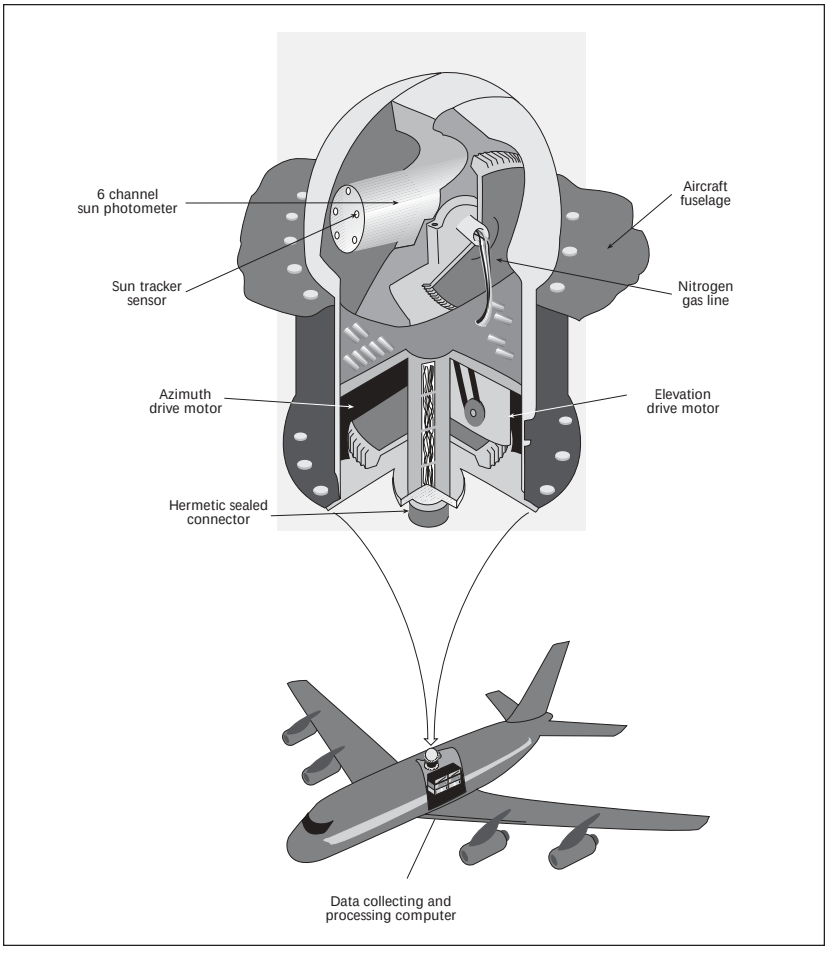
Application Note #12

A NASA laboratory employed a notebook-PC-based data acquisition system to gather data for atmospheric research. The notebook-based system helped reduce the size, weight, and cost of the airborne test application, while concurrently increasing its performance, data storage, and display capabilities.

Application Summary

A NASA research lab developed a tracking sun photometer to obtain accurate, multispectral atmospheric extinction measurements at various altitudes. The sensor is mounted through the aircraft fuselage for an unobstructed view of the sun, while the delicate instrumentation remains protected inside the aircraft.

The sun photometer's solar tracking system is designed to track and acquire data with great accuracy even during aircraft movement. Its cylindrical detector module contains six silicon photodetectors, a sun tracking sensor, and a temperature sensor for controlling the environment inside the module. Its mechanical drive train incorporates stepper motors, which are suited for use with digital control systems.



The sun photometer is composed of a solar-tracking system, detector module, temperature control system, nitrogen purge system, mechanical drive train, and data acquisition system

Approximately every two seconds, the data acquisition system connected to the sun photometer samples sensor data; synchronizes it with other altitudinal, longitudinal, and latitudinal data provided by the aircraft data system; and saves the acquired data to disk.

The acquired data (including photodetector input such as temperature, tracking error, sun azimuth angle, sun elevation angle, and UTC time) is software processed, permitting the system to display Langley and optical-depth 3D plots in near real-time for in-flight feedback.

Original Solution

The original data acquisition system was based on a Hewlett-Packard HP9816 computer. The HP9816 was equipped with floppy disk drives and a printer, and employed an HP 12-bit multiplexing A/D converter and digital I/O to control the sun photometer's position and collect data from its sensors.

Unfortunately, this rack-mount configuration had several disadvantages for airborne data acquisition. For example, it:

- was heavy, which increased fuel costs
- was bulky, and thus needlessly consumed valuable cabin space
- required AC power
- inadequately displayed data (i.e., the HP9816 was unable to display real-time graphics)

Also, advances in portable PC technology were threatening to render the HP9816 obsolete.

IOtech's Solution

Because of the drawbacks previously described, the customer elected to replace its old system with IOtech's DaqBook, a notebook-PC-based portable data acquisition system. The new system weighs under 20 pounds (including battery pack) and occupies a fraction of the space of the old one.

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Furthermore, the DaqBook is battery operable, permitting it to function independently of the aircraft's power system, an important consideration in airborne applications. The new system's notebook PC features a large hard drive, enabling the acquisition and retention of more data than was possible with the HP9816. Also, in contrast to the HP9816, the notebook PC can display high-resolution real-time graphics.

Standard features of the DaqBook play key roles in this application. Programmable digital I/O lines prove valuable for controlling stepper motors that run the drive train.

Data is viewed in real time, but with the DaqBook's parallel-port pass-through mode, hard-copy reports can be printed during the actual data acquisition. Also, reporting from gathered data is easy due to DaqView's ability to save data in a spreadsheet compatible format.

Conclusion

The DaqBook's considerable cost and weight advantages have allowed the NASA research laboratory to maintain a cost-effective in-flight test program.

DaqBook/2000 Series

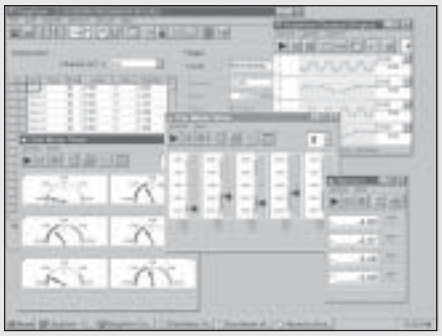
The DaqBook/2000® series of portable data acquisition devices are available with either a built-in Ethernet interface (model /2000E), or a parallel-port interface (model /2000A or /2000X). The Ethernet-based DaqBook/2000E can attach directly to the Ethernet port of a PC, or to an installed Ethernet network. The DaqBook/2000E also contains three parallel expansion ports, which can attach to an additional three parallel DaqBooks, thereby quadrupling the channel capacity of a single Ethernet link to the PC.

Features

- Analog input, frequency input, timer output, digital I/O, and analog output; all in one compact and portable enclosure
- Available with either an Ethernet PC connection, or a parallel port which can link directly to a PC parallel port, or with an interface to PCI bus, PC-Card slot, or ISA slot
- 16-bit, 200-kHz A/D converter
- Synchronous analog, digital, and frequency measurements
- 8 differential or 16 single-ended analog inputs (software selectable per channel)
- Expandable up to 256 analog input channels, while maintaining 200-kHz (5 µs per channel) scan rate
- Expandable up to 1024 analog inputs with DaqBook/2000E plus three slave parallel DaqBooks
- 512 location channel/gain FIFO, capable of scanning all channels, including expansion channels and digital/counter channels, at 5 µs per channel
- Trigger modes include analog, digital, & software, with <5 µs latency
- Virtually infinite pre-trigger buffer
- Optional four channel, 16-bit, 100-kHz analog output card installs internally
- 40 digital I/O lines scanned synchronously or asynchronously with analog inputs
- Digital I/O is expandable up to 272 lines, including isolation and relay closure options
- Four cascadable counter/pulse input channels scanned synchronously or asynchronously with analog inputs
- Two timer/pulse output channels
- Digital calibration — no potentiometers
- Multi-unit scan synchronization
- Vehicle network interface option

Signal Conditioning Options

- Signal conditioning and expansion options for thermocouples, strain gages, accelerometers, isolation, RTDs, etc.—over 40 DBK I/O expansion options in all



Software

- DaqView™ software with eZ-PostView™
- Included drivers for Visual Basic®, Delphi™ and C++ for Windows®; DASYLab®, TestPoint®, and LabVIEW®

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