Remote Data Logging
USING PC-BASED INSTRUMENTS

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ENVIRONMENTAL
Analysis

Up until the late 1980s, remote data acquisition was traditionally achieved by leaving standalone data loggers to record events and returning once in a while to collect data and/or change settings. Further, the actual data acquisition required bespoke hardware and software solutions, and was prohibitively expensive for all but the high-end applications. Then, in the early 1990s, PC-based instrumentation appeared on the scene and data logging changed forever.

Since the early days of electronics, data acquisition techniques have enabled us to measure quantities, such as temperature, light levels, voltages and currents, and represent them in easy-to-interpret formats, such as tables and graphs. We have also had the ability to store data for future reference/interpretation and act upon the data when limits are exceeded.

However, until about fifteen years ago, to implement data logging required expensive hardware, dedicated software, highly-skilled technicians and a reasonably large budget. Thankfully, the arrival of PC-based solutions in the 1990s stripped data logging of its complexity and cost. The hardware simply slots into - or more frequently connects to - a PC and user-friendly data logging software does the rest: often guiding the user through logger configuration and interrogation.

The simplification of configuring and interrogating the data logger are far from the only benefits PC-based solutions deliver though. Clearly, once data is captured by a PC, not only is its storage simple but so too is its transfer over a network. This last aspect is of particular appeal to those either developing a data logging application from scratch or adding remote data logging to an existing infrastructure.

For example, many factories and offices are already over-loaded with routed wires and cables, so, compared to installing new cables just for data acquisition purposes, the prospect of sending measurements down existing network cables is very appealing.

As it is most likely that the factory/office will already have PCs dispersed in and around the site, (plus some sites might be connected to each other via intranet or internet), why not exploit this existing connectivity?

From afar

Internet Protocol (IP) networking, when integrated into a PC-based data logging scenario, enables the capture of data in one location and its representation elsewhere. Pico Technology, for example, announced its support of IP networking in 2000, and its customers were quick to adopt the technology: a strong indication that the requirement for PC-based 'remote' data logging solutions had always been present but that costs had, until year 2000, severely restricted its implementation.

Pico's solution for IP networking-based data logging was realised in two of the company's software products: PicoLog, software for PCs fulfilling short-term or intermittent data-logging roles; and EnviroMon, which runs on Pico's EnviroMon data loggers, used for continuous or long-term data logging.

Upgrading the two products to support IP networking was relatively simple, although Pico did have to take two different approaches:

- EnviroMon, already tailored for standalone applications, was revised to include a standalone 'agent' program, which passes messages received on an IP network to the data logger hardware via the serial port.

- PicoLog, on the other hand, was revised to work under a 'client-server' scenario and the 'remote instances' of PicoLog appear on the 'local instance' as an IP device.

Remote access through IP is of course extremely appealing to those developing systems that employ the Linux operating system (OS). The Linux OS is now well established and its powerful networking capabilities, and the fact that it requires no license fee, give it a considerable edge over Windows: a licence fee for which could easily add 20% to the cost of even a basic PC-based remote data logging system.

What a view

An alternative to sharing the data as it is recorded is to publish, at regular intervals, views of captured [and interpreted] data on to a web site. There are two compelling reasons why this might be done:

- To publish data for the general public and/or customers to view: for example you might be storing products and/or goods that are sensitive to heat, humidity or light and wish to demonstrate that your storage conditions comply with customer requirements.

- To post data for internal use: for example the remote monitoring of fridges, freezers and heating ventilation and air conditioning (HVAC) systems.

One method of achieving this is to have the PC-based data logger automatically upload graphical representations to a web server, and for the server to then update one or more pages of a web site. In Pico's case, the company devised three simple files/scripts to enable users of its EnviroMon system to post JPEGs of plotted parameters on to a web site.

The files are: Upload.ftp, a simple seven-line script that the user edits to define the web site's URL, username and password; Enviromon.html, copied to the web server, this is the page to which data will be posted; and Enviromon.bat, run as a scheduled task on the PC connected to the data logger.

All three files are easy to edit, in an application like Notepad. Once installed, they enable the user to automatically post clear and easy-to-interpret colour graphs portraying historical data. In addition, it is possible to make available results tables, which users can download (as comma separated value [.CSV] tables) for a detailed account of the data captured. See box – 'Feeling the heat'.

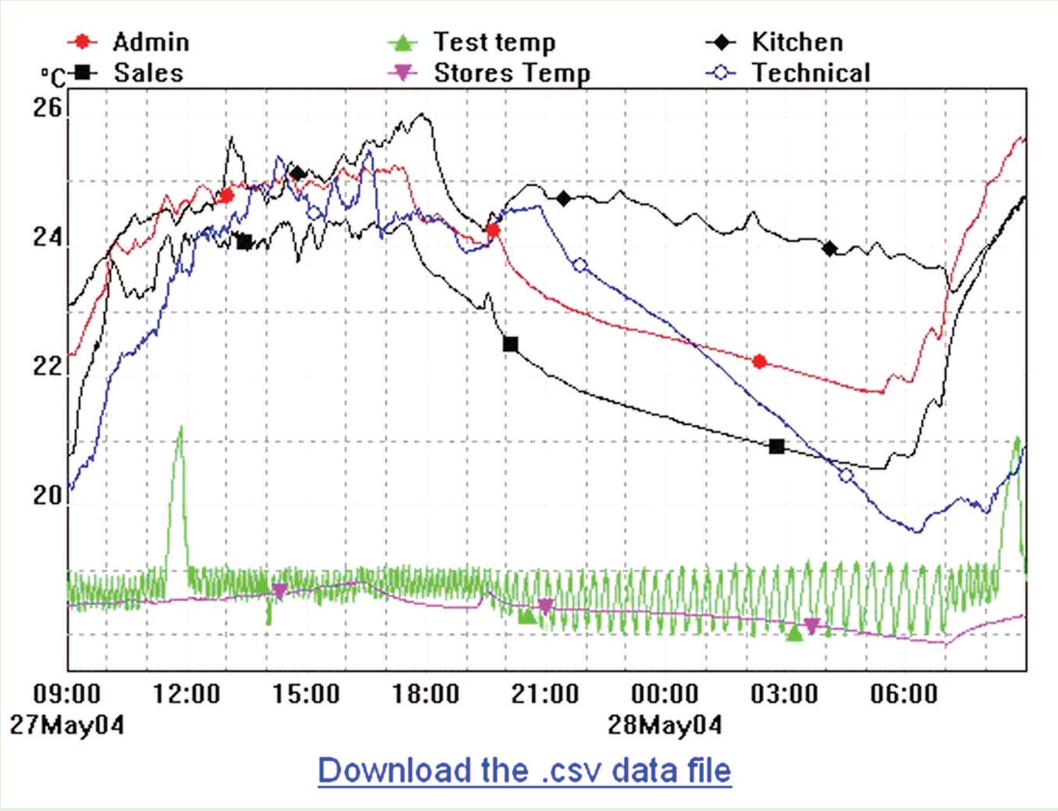
Alarming results

Under most PC-based data logging scenarios, user notification, ideal for when critical limits are reached, is very easy to implement. For example, a number of PC-based data logging units now support GSM's short message system (SMS). This means it is possible to, for example, send a service engineer a text message if one or more critical temperatures (or other parameters) have been reached.

Further, some data loggers allow separate messages to be assigned to each of their channels, hence the engineer could be made aware of exactly what the problem is. Plus, if the alarm condition is reached when the engineer is on call, he could, from the comfort of his own home, either access live data via IP networking or simply view images (graphs) posted onto a web site in order to decide whether or not a site visit is necessary.

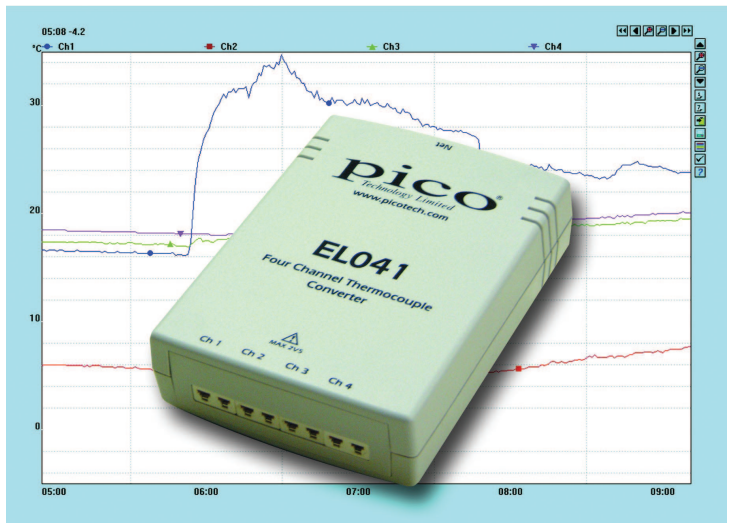
Similarly, an autodialler (programmed with a list of emergency numbers and a number of specific alarm messages) could be used.

Feeling the heat



Many users are heralding the automatic publishing of data acquisition results on a web site as one of the most significant developments in low-cost remote data acquisition that the industry has ever seen. Not only is the posting of graphical representations (like the one above) as simple as installing and editing a few simple scripts, but people viewing the data do not need bespoke software to view the graphs or download the tables.
For proof of how effective this can be visit www.picotech.com/dynamic where Pico regularly posts data (temperatures and current consumption) being monitored in its R&D facility near Cambridge.

Reaching that critical temperature



Temperature is by far the most common parameter people wish to record. For example, the extremely high or low temperatures associated with some industrial processes, the sub-zero temperatures at a ski resort, or the temperatures with and around sensitive pieces of equipment and embedded systems: all can be measured and presented elsewhere thanks to any of a number of remote data acquisition techniques – as discussed within the main body of this article.

As for acquiring the temperatures, one way would be to employ thermocouples, a thermocouple converter, such as Pico's EL041 (which was announced in the May/June issue of IET, pp38), and data logger (such as the EnviroMon EL005).

The EL041 has an effective temperature range of -270 to 1820 degrees C (using thermocouple types B, E, J, K, N, R, S and T), is accurate to 0.3 per cent +/- 0.5 degrees C and has a resolution of better than 0.2 degrees C. It also features built-in cold junction compensation (CJC).

The EL005 data logger can record up to 250,000 readings and sample the thermocouples as frequently as once every minute or sample at up to 4 hour intervals. Once readings have been captured, a number of things can be done with them. They can:

- be saved to the PC;
- have mathematical operations performed (such as comparisons) and then be saved to the PC (as temperature differences for example);
- be automatically compared against user-defined limits;
- be used to notify the user, via landline or GSM phone, when critical limits are reached; and/or
- be posted to a web site for company or world-wide viewing.

Data acquisition/ logging top tips

Simple questions to ask yourself before developing a data logging system:

- **Who is going to use the data:** an engineer; a production department; a service engineer; and/or a consumer? Also, do you need to adhere to any standards, such as ISO?
- **Why do you wish to capture the data?** Verification that a process is working correctly; to understand an environment or process; to improve a process; to prove (for regulatory purposes) that a process is within specification; and/or to control a process?
- **How will the end-user need to visualise the data?** Options here may range from displaying no data at all and sounding an alarm if a quantity (temperature for example) goes out of range, to displaying a wealth of historical data in table and/or graph form.
- When do you need to acquire/log data? Continually (for research and regulation) or only log events when something goes wrong (test and diagnosis)?
- **What are you trying to log?** Temperature, humidity, pressure, noise/vibration, pH, light levels – in fact any quantity that can be conditioned into a voltage/current can be logged. The answer to this may force you to use specialist sensors and transducers.
- **Where?** As for location, this may well govern the complexity of your data-logging scenario more than any other factor – and may well make you consider wired or wireless remote data logging.

Conclusion

PC-based data logging, IP networking, the publishing of views of data onto a web site and GSM text messaging – all have broken down the cost versus complexity barriers that have, to date, barred progress in many environmental monitoring and data logging applications.