In California, the agricultural community requires efficient water management for their crops. The drought experienced during the first part of the 1990s, for instance, took its toll on everyone in California, including the farmers. State regulations threatened penalties for wasted water, even if a farmer owned a well. One solution to this was to offer farmers the ability to fully automate the irrigation process. Automation encompassed capabilities such as filling water tanks and applying water until the soil contained the desired moisture level. A continuously updated database could generate water usage reports.

A company called Geomatics, Inc. was formed to develop an automated irrigation system called AgriMate. My work with Geomatics involved developing the system using LabVIEW from National Instruments. LabVIEW, which provides a user-friendly interface for the typically nontechnical farmer, offered Geomatics a programming tool for developing a solution in less time than using a traditional programming language.

AgriMate links a series of tensiometers for soil moisture, valve solenoids, pressure and flow transducers, and pumps in an orchard to a field processor that is hosted by a Macintosh running LabVIEW. The interface to the field processor is made using RS-232 serial communication from the Macintosh printer port. The field processor is configured with analog input, latch, and relay boards. The wiring from the various sensors and transducers is connected to the field processor in a star configuration.

The LabVIEW graphical user interface (GUI) provides the farmer with a general status panel. Status is identified by custom indicators that resemble various areas of interest to a farmer, such as tank level, pump and valve status, temperature, soil moisture, and property security. LabVIEW provides the ability to import objects and animate them programmatically. The farmer can monitor this status panel and simply watch for an indicator to turn from green to red. This change of color indicates that the irrigation process needs attention. With the buttons on the right side of the screen, the farmer can investigate the reason for a status change by accessing the monitor-and-control panels of AgriMate. The farmer can monitor and control the tank level, valve position, pump status, and soil moisture with these panels. The farmer can modify set points to change a watering schedule. Charts display soil moisture and water applied for a given month. Rainfall is monitored so that the additional water is taken into account in the watering schedule.

Streaming data to disk is easy to program in LabVIEW. Applied water, water usage, tank level, and rainfall are some of the data stored in an irrigation database file for each year. The farmer can read back data in the same charts and compare it with the current month. A spreadsheet database created by AgriMate provides a hard copy irrigation status report. This report is updated daily or hourly when rainfall is detected.

Automation makes other features possible; LabVIEW makes programming easy. All irrigation is coordinated to comply with the local power company’s time-of-use provisions. Farmers can save 50 percent in pumping costs because they can irrigate at night during the preferred hours. When the tensiometers require occasional water top-off, the system identifies which tensiometers require service.
In the event that one of the soil moisture tensiometers is damaged by an animal in search of water, the system flags this damage. Bugs and spider webs have also been known to cause problems by clogging the minisprinklers. This problem is eliminated by a flush cycle programmed on all irrigation blocks for 10 minutes each night at midnight.

LabVIEW proved the best programming environment for developing this automated irrigation system. AgriMate is an effective tool for farmers to monitor and control water usage, reduce costs, and document efficient water usage. Its intuitive GUI is easy to program because custom objects are easily imported and animated in LabVIEW. Streaming data to disk is also easy to implement for producing historical plot information and hard copy printouts. The flexibility offered by the LabVIEW programming environment makes possible customization limited only by the programmer’s creativity.

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