

## Using SCADA for Agricultural Irrigation

Farm-based SCADA systems provide frost protection, maximize crop yield and prevent excess water runoff.

By Kevin Connolly and Christopher Little

### Overview

Supervisory Control and Data Acquisition (SCADA) systems are common place at municipal utilities and manufacturing facilities. After five years of developing cellular-based systems to monitor agricultural irrigation, integrator KC Enterprises Ltd. observed that farms are a lot like outdoor factories and would be better served by radio-based SCADA solutions. Their new system is based upon VTScada HMI software from TriHedral. In this article, KC Enterprises president, Kevin Connolly, describes the system and how it is helping their customers conserve water, save money and prevent runoff.

### What is SCADA?

Organizations such as water & wastewater utilities typically have monitoring and control sites spread over a wide geographical area. SCADA systems use Human Machine Interface (HMI) software to poll the remote telemetry units (RTUs) at each site via radio. The system stores this information in an historical database and uses it to automate various aspects of the physical process. Users interact with the system via a series of display pages.

### KC Enterprises Ltd.

Kevin Connolly is the president of the Massachusetts-based systems integrator KC Enterprises Ltd. ([www.irrigationautomation.com](http://www.irrigationautomation.com)). For the last six years, the company has created irrigation monitoring and control systems for over seventy farmers in the United States and Canada serving major national juice and wine producers.

The company started off creating read and write systems that collected data via cellular modems and displayed the information to farmers allowing them to control their equipment using individual web pages. "Since the beginning we have been a hundred percent web based," says Connolly. "We were using the CDMA network and Sierra Wireless AirLink Fastrack Xtend CDMA 1xRTT modems."

These systems were designed to address a variety of issues.

Over-watering - Crop over watering is expensive for farmers, taxes the local water supply and can be detrimental to some crops. "Water is a huge issue," says Connolly, "Water is a commodity right now in parts of the country, so it is critical to be able to monitor and control the amount of water that is being used."

Chemical runoff - Excess watering also produces runoff which releases agricultural fertilizers and pesticides into the water table.

Frost protection - Irrigation systems play a major role in preventing frost damage by calculating wet bulb temperature. This combination of wind speed, air moisture and temperature determines when frost is imminent. Watering crops before a frost creates a protective layer of ice around fruit that melts harmlessly once the frost has passed. Connolly points out, "By using wet bulb temperature to start and stop an engine the farmer is able to cycle his pumps throughout a frost night; thereby, saving water, fuel and importantly man hours."

### The move to SCADA

Over time, their customers began to require more real-time data. "Cellular modems can provide real-time data," says Connolly, "but the cellular plans are very costly which is why we offered farmers only a snapshot of what was going on. As we reached out to different areas of the country, we realized that cellular modems are not necessary because farms are set up differently."

"On a farm, the office is usually right there on site in a central location with the farm spread out around it. We can put a radio right there at the office that looks out over the whole farm. In other words, we can use SCADA systems to provide real-time system data."

This approach opened the door to automating the irrigation process. "What makes us different from other companies is that our systems don't just monitor soil moisture, temperature and other conditions; they also act upon those conditions. The system not only starts engines, it starts them in the proper way. By that, I mean it idles the engine up before going to full throttle."

"We actually throttle to discharge pressure. By using VTScada software we eliminate the single point of failure that many competitors offer. In our system the intelligence is in the controller not the software. If the computer running the software should experience problems the scheduled action will still take place as the controller stores the commands received from the software."



A user interface page created using VTScada.

Adding automation to the system provides additional benefits.

**Automation increases yields by eliminating under-watering** - "Labor is a considerable issue. Crops in remote fields are often under-watered for long periods because no one is available to water them more often. Watering remotely means you don't have to send people out there three or four times a day. It makes much more sense."

**Automation maximizes worker efficiency** - "Prior to automation, on a frost night the farmer would have to send out the entire crew to work all night. They would start pumping water around eleven and let it run until seven the next morning. They had to stand out there the whole time watching the engines run. Then they would work the entire next day. It was not a lot of fun."

### VTScada HMI software

KC Enterprises developed a new SCADA-based system for their customers based upon VTScada HMI software from Trihedral ([www.trihedral.com](http://www.trihedral.com)).

"Basically, the way the system works is that an FW Murphy EMS4670 controller collects the data and acts upon it." This new system helped to reduce costs by automating the irrigation process based on weather forecasts and sensor readings from the soil and air.

"We did a lot of research about what different software companies provided," says Connolly. "We looked at many other HMI products but they were far too complicated. We heard about VTScada from another client who was already using it. These days the need is for real-time data that provides historical data. VTScada software provides all of that"

Paul Frink is an engineer with KC Enterprises. "What we like about VTScada is its scalability," says Frink. VTScada includes an extensible scripting language that can be used to modify every aspect of an application, from simple user interface customizations to complex data-handling functions. "It is easier to use from a programming standpoint. This allows us to offer our customers more features and more value as time goes on. There are a lot of things we want to do in the future."

Support was another key consideration for Connolly when selecting VTScada. "Trihedral offers support above and beyond. We developed our own business around support. We wouldn't be here today if we were not available by phone to our clients."

### Historical database

"The historical data is extremely important," says Connolly. "The ability to see data from last night, last week, last year, the last three years; that's incredible. It helps farmers to make the right decisions, like how much water to apply and when, or how much fertilizer is required based on current conditions. If you know what your crop yield was last year, you can look back over the historical data. You can see what you did and what the weather conditions were and make decisions for next year. At what levels do I add more water and for how long? Am I over-watering or under-watering?"

Farmers can use the system to make changes on-the-fly. They can start and stop pumps by temperature, date and time. "Say the discharge pressure is 50 lbs and the farmer wants to run at 60 lbs. They simply enter that number (50 lbs) and, low and behold, the engine begins to throttle up to pressure and runs at 60 lbs. They can change the timing in order to warm up and cool down properly. They can do a lot of things now, from a remote location that they could never do before."

### Alarm dialing

VTScada includes an integrated alarm dialer that contacts users via emails, text messages or text-to-speech phone calls based on predetermined set points. "This software provides a great interface. It allows you to alarm individual devices in the field including radios. We are alarming things like ambient air temperature, soil moisture conditions and shutdown conditions based on engine temperature, discharge pressure, oil pressure." By doing this you actually create a pre-warning system as well as a monitoring and control system.

The VTScada Alarm Dialer also sends text messages each time the engine starts and stops. "For example, we get messages when a temperature start occurs for any reason including satisfied temperatures. That's all valuable information."

### Satisfied customers

"Just yesterday we were speaking with a customer here in Massachusetts. This grower was out watering on a frost night. Since everything was going well, he decided to go home and get a bit of sleep. An hour later he got a text message saying that his engine had shut down. It had snapped a belt even though it was relatively new. He was able to get back out and fix the problem before he lost his crop."

"Another customer in Canada received a phone call from VTScada that informed him that his engines were about to start because the temperature was falling. He called his brother next door to tell him to get out and start his equipment. His brother never would have gotten out there without that phone call because his system didn't poll continually like ours does. He would have been twenty-five minutes late, which on a frost night could be critical".

### Conclusion

"I am proud that we have been able to provide our clients with something they have been seeking for a long time; a system that saves water, fuel and man hours; and helps them to enjoy a better quality of life. While profitability and productivity are certainly important aspects of business, there is a certain satisfaction one gets from knowing their company has provided a better way of life for the company and its employees and their families."

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