DEVELOPMENT OF NEXT-GENERATION PRECISION CONTROLS TO OPTIMIZE APPLICATION AND EFFICIENCY OF IRRIGATION OF GEORGIA PEANUTS

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Objectives

To develop and test the next-generation electronic controls for the UGA/NESPAL variable-rate center pivot irrigation (VRI) system. Specifically, we will develop a unique, more efficient, more reliable, and cheaper control system that will not be dependent on foreign suppliers.

Materials and Methods

This research project involved development of electronic hardware and software to accomplish variable-rate control of individual sprinkler control zones on a center pivot. The current Farmscan VRI system is based on electronics and software developed and maintained by Computronics from Perth, Australia. While the Farmscan system is functional, it is dependent on supplies and updates from a vendor many time zones away.

Hardware

We selected relatively inexpensive, off-the-shelf components to form the basis of our new VRI control system (Fig 1). We believe that the future of smart electronics will be based on Internet Protocol (IP) compliant devices that a user anywhere on the Internet can communicate with. Therefore, for the main communication method between control components, we chose to use Ethernet over AC power (HomePlug) communications. HomePlug allows for simplified networking and powering setup and extended networking abilities, providing for up to 14Mbps bandwidth over normal AC wiring.

To control individual sprinkler zones (on/off control), Optimation OptiLogic Remote Terminal Units (RTUs) were used. These modularly designed units allow us to plug in various analog and digital inputs and

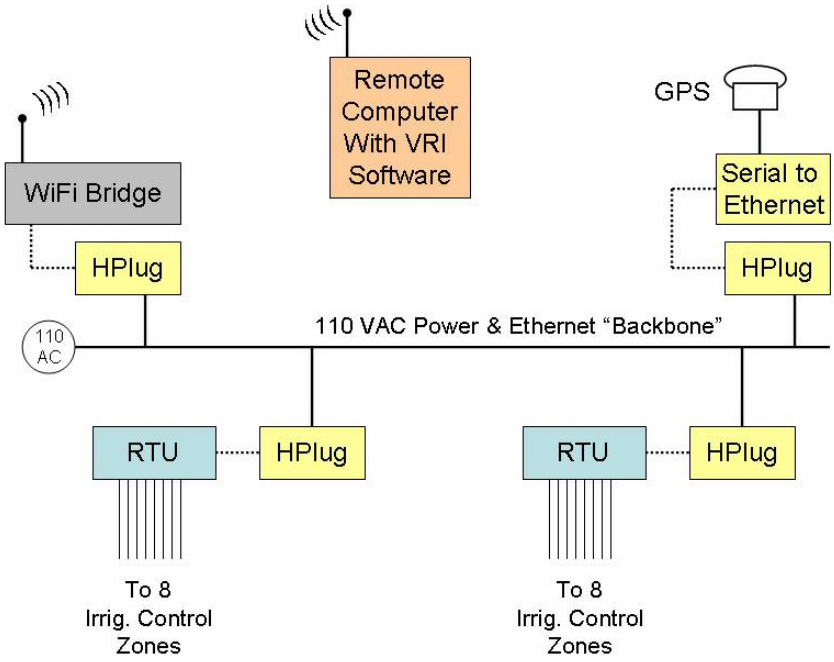

Figure 1. Schematic of HomePlug communication backbone on pivot.

outputs. RTUs allows you to monitor and control equipment and systems spread throughout an area. Our test system involved two RTUs and we plugged in 8 channel relay boards in the RTUs so that up to 8 individual sprinkler zone solenoids could be managed separately at each RTU. We communicated with the RTUs via an Ethernet 10BaseT connection through a Gigafast HomePlug adapter.

At one end of the HomePlug AC line, we connected a WiFi Bridge to allow wireless network connection between the HomePlug network (the RTUs) and a remote computer that would serve as central controller.

Software

The variable-rate control algorithms were coded and programmed in MS Visual Basic language. Optimation supplies basic programming function libraries via a Software Development Kit to facilitate code writing.

The software was designed in modules for various system components so that any module can be swapped out if changes are needed. To date, we have developed modules for converting water application rates into time discrete control data; for communicating application rate data over the HomePlug network to the RTUs; for aquiring GPS over the HomePlug network and converting lat/lon coordinates into a pivot angle (clockwise from North). Inherent to the software design is the ability to handle data/events from a module, decide what to do, and possibly pass information on to another module.

Preliminary Results

We have started field testing of hardware and software components on the NESPAL center pivot. A single 110 VAC line connects the two RTU units, GPS, and WiFi bridge. A laptop PC with WiFi wireless network capability hosts the developed software. With this arrangement, the PC can communicate via anywhere on the Internet to the RTUs and GPS.

Communication has performed successfully over the wired (HomePlug) and wireless (WiFi) connections, ie. we have a stable network connection. However, cycling sprinkler zones on/off has not progressed as far or as smoothly as anticipated. Apparently some of our error detection/correction algorithms are not performing as needed.

Preliminary Conclusions

The Optimation OptiLogic RTUs have proven to be flexible, networkable, and robust hardware controllers. However they are not as weather proof as we would have preferred. The HomePlug method of communicating via Ethernet over a 110 VAC line has worked well so far.

Software continues to be the key area for our ongoing development activities. We are just now developing modules for controlling the end gun operation as well as pivot speed control. We are also beginning development of map-based software for a PC to allow for end-user creation of irrigation application maps.

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