GP2 Advanced Data Logger and Controller - An Environmental Controller for Experimental Research and Plant Studies

Adam Ellingham, Martin Goodchild, Nick Burlton, Karl Kühn and Stephen Rusanen

Abstract

This poster presents the innovative control functionality enabled by the Script Editor feature of DeltaLINK 3 software - when used in combination with the new GP2 Logger and Controller. This powerful new Script Editor function gives users an accessible way to create sophisticated mathematical functions and models that can be applied in real-time to the measurement data collected by the GP2 - providing useful control outputs from the combination of different types of measurements and/or multiple sensors. Potential applications are numerous, including areas such as the calculation of evapotranspiration, irrigation control and disease prediction. In the experimental work shown below we have created control algorithms that enable a GP2 Logger and Controller to simultaneously deliver precise irrigation control for a flood tray and control the soil temperatures for two propagators. The GP2 controlled flood tray irrigation events use feedback from an SM300 Soil Moisture Sensor to activate a pump to transfer water from a reservoir to a flood tray. Feedback from ST4 Soil Temperature Probes enabled the GP2 to maintain soil temperature control in 2 propagators during the seed germination phase for a variety of vegetables.

Delta-T Devices

Experimental Control in a Polytunnel

A key factor in performing rigorous research is ensuring the reliable control of experimental conditions. The GP2 from Delta-T Devices is a multi-functional data logger and controller capable of complex calculated measurements and advanced feedback control. This poster is a demonstration of how the GP2 can be an invaluable tool for conducting scientific research.

A GP2 was used in a small scale experiment to illustrate its ability to reliably and simultaneously control two important experimental parameters essential to plant growth, namely, seedling germination temperature and soil moisture. The experimental apparatus, shown in Figure 1 below, was set up in a polytunnel in the grounds of Delta-T Devices. A variety of vegetables have been grown from seeds through this GP2 controlled dual propagator and flood tray system. Propagator temperature and flood tray irrigation control has been enabled by creating appropriate Scripts for the GP2 using soil moisture and temperature measurements.

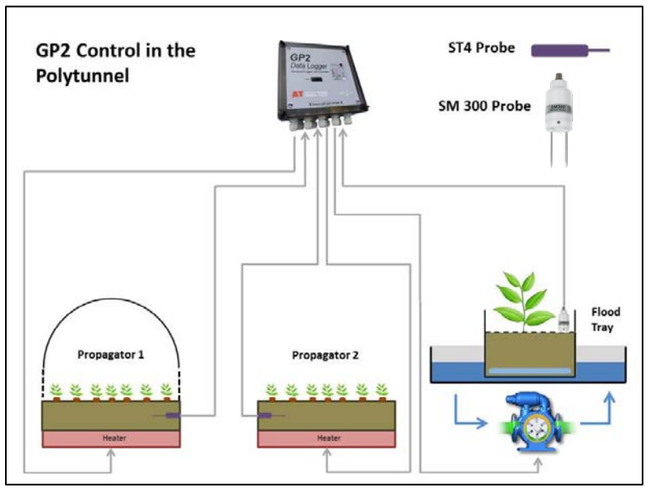

Fig 1 – Diagram showing the GP2 Control of the Flood Tray and Propagation System.

The flood tray irrigation system employs an SM300 soil moisture (and temperature) sensor to provide the GP2 with the Volumetric Moisture Content (VMC) of the soil in a potted plant, as shown in Figure 5. When the SM300 measures the VMC level of the soil below a level (pre-set by the user into the GP2), the GP2 switches a water pump on for a fixed duration to fill the flood tray. The propagators use ST4 soil temperature sensors to provide feedback for the GP2 to switch the sub-soil propagators heaters on and off, in order to maintain each propagator's temperature within the user's desired range.

GP2 Propagator Temperature Control

Figure 2 shows a DeltaLINK screenshot of propagator temperature and heater control data showing the 'ambient' temperature as indicated by 'Cold junction' (within the GP2) and SoilTemp(3) from the SM300 located in the plant pot on the adjacent flood tray, as shown in Figure 5. The propagator's soil temperature ST4 sensor data, SoilTemp(1) and SoilTemp(2), shows that the temperatures in each of the propagators remained within the minimum daily temperature target range of 28 and 32°C due to the simultaneous heater control provided by the GP2. Over the same period the 'ambient' temperature fell below 20°C. It can also be seen that the heater of propagator 2 operated over twice as often as the heater of propagator 1, this was due to the propagator 2 not having the transparent cover fitted which increases heat losses. As a result the rate of cooling in propagator 1 was approx. 1.5 times slower than that of propagator 2.

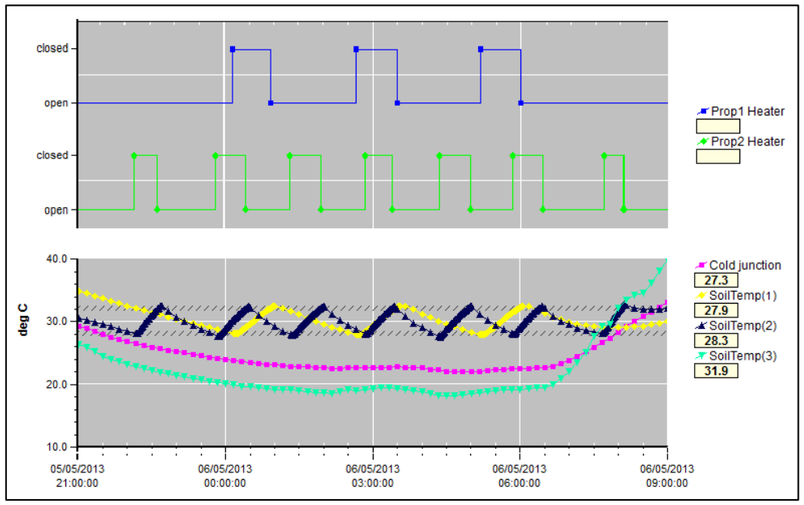

Fig. 2 – DeltaLINK screenshot showing the GP2 controlling the soil temperature in two propagators by switching heaters on and off.

GP2 Flood Tray Irrigation Control

Figure 3 shows soil moisture and flood tray irrigation control data for a period of 24hrs with 2 flood tray pump activations at 16:00 on the 05/05/2013 and 14:00 on the 06/05/2013. As shown the pump activated when the VMC (measured by an SM300) drops below 45%.

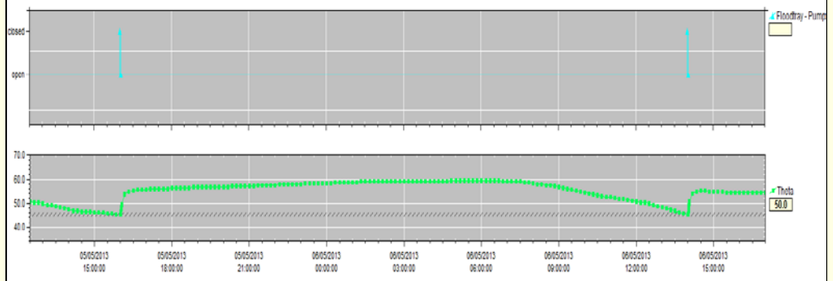

Fig. 3 – Graph Showing the GP2 controlling the soil moisture by activating the Flood Tray pump

Fig. 4 – The flood tray, GP2 and propagators in the polytunnel at Delta-T Devices. In the experimental work shown here we have successfully used a dual propagator and flood tray system to grow

Fig. 5 – An SM300 Soil Moisture sensor providing VMC feedback for flood tray irrigation control.

Conclusions

In this poster we have demonstrated how the GP2 Data Logger and Controller can be employed to simultaneously control propagator temperature and flood tray irrigation in order to grow a variety of vegetables with minimal manual intervention.

The GP2 along with the DeltaLINK 3 software can enable a wide range of sophisticated control solutions suitable for use in plant science research. The GP2 is available with up to 6 relay outputs allowing alternative propagator and flood tray permutations. For more details please email sales@delta-t.co.uk

For more information regarding the GP2 Data Logger please contact: sales@delta-t.co.uk
DeltaLINK 3 is available free of charge at www.delta-t.co.uk

Delta-T Devices, 130 Low Road, Burwell, Cambridge, CB25 OEJ, UK