DYCOR™

The Intersection of Innovation and Technology

DYCOR WHITEPAPERS

RETROFITTING LAB EQUIPMENT WITH SMARTVUE®

Dycor Technology Application Whitepaper

Retrofitting Lab Equipment with SmartVue®

Background

Dycor Technologies specializes in creating custom Data Acquisition and Industrial Control solutions using a combination of proprietary technology and off-the-shelf components. Applications for our products are deeply varied, and this whitepaper presents a functional example of a solution that was developed for specific client needs.

Abstract

This whitepaper discusses the implementation of a SmartVue PID Controller for the replacement of failing control systems on Laboratory grade Mechanical equipment where the cost of repair or replacement is available, but upgrading would improve functionality of the equipment, extending its useful life.

Problem

Equipment built prior to solid-state sensor technology often succumbs to age as sensors no longer stay within tolerances, or are incapable of consistent function. If however, these older pieces of equipment are fitted with updated sensors and controllers, their service life can be extended significantly.

In this Whitepaper, Dycor was contacted to assist with the retrofit of an aging but otherwise sound laboratory grade shaker/incubator which began to exhibit unreliable temperature control. As the equipment was ideally suited for use in the clients lab environment retaining the equipment was preferred to replacement.

A more reliable and stable sensor and control mechanism was needed to ensure tightly regulated chamber temperatures, and mechanical control. Although proportional temperature controllers are both readily available and cost effective, the client preferred the options provided by a custom controller solution.

Application Design

A replacement controller for the lab equipment would be required to control all existing functionality of the equipment, while providing capabilities beyond the original equipment capabilities.

To satisfy the needs of the client, the following criteria were required to address these needs:

- Replace existing control functionality
- Extend run-time capabilities (temperature modelling, agitation schemes)
- Capture additional data from new sources
- Track, log, and provide operational feedback
- Remotely control and access data

Dycor worked with the integrator to provide key hardware solutions to meet each of the needs identified.

Dycor SmartVue Retrofit Solution

Though a simple PID control solution could replace the failing controls, Dycor saw the opportunity to engineer a more robust solution using the SmartVue Controller. Given the feature set of the SmartVue, replacement of the aging sensors on the device would permit far greater control and new operational features.

Despite the tight confines of the original controller space, the small size of SmartVue could be accommodated within the front panel space formerly occupied by temperature set point controls. To complete the system Dycor provided two new RTD sensors and a proportionally controllable solid-state relay to replace the original capillary sense tube thermostat.

The original safety thermostat would be left in place after verifying reliable operation and adding a calibrated dial to eliminate setting cutout temperatures by trial and error. The secondary RTD sensor provided by Dycor would be used by SmartVue to provide an additional safety mechanism to the mechanical thermostat. In the event of a control system malfunction in which the set threshold temperature is exceeded, a latching relay would shut off the heater power.

Smartvue provides with its built-in Ethernet port and USB host interface, the ability to capture and retrieve historical control data. This data can be readily logged to internal or external memory and monitored remotely in real-time anywhere from any computer with the downloadable SmartVue Remote application. All settings can be administered remotely as well - ensuring that all operations of the unit were maintained, and new logging and remote administration functions would improve the management of tasks for the machine.

Practical Implementation of Dycor Components

Existing Incubator Heating Components

The original Environmental shaker Control Panel utilized two capillary thermostats to control the chamber temperature and to provide a safety over temperature cutout control. Both thermostats used long copper tubing to connect the temperature sense bulbs inside the heating compartment with the front panel controls.

Inside View of Control and Heater Compartment Sensor Mounting

The heating compartment consists of an intake recirculation fan drawing air from the sample chamber and then forced through a finned heatsink with an integral 350W electric heater. Air is then circulated back to the chamber to be cycled again. The original temperature sensor bulbs were attached to the heating box interior wall near the chamber outflow opening. Chamber air is returned through the original hexagonal air passage.

Chamber Heater Circulation Passages

Incubator Sensor Changes

To prepare for the SmartVue upgrade, the temperature-setpoint thermostat bulb was removed from the heating chamber while the original safety thermostat was left in place. Two RTD PT100 temperature sensors were added in place of the original thermostat bulb to be connected into the SmartVUE controller. One sensor connects directly with the SmartVue RTD inputs, while the second sensor utilizes a small RTD to 4-20mA current loop module and connects to channel one of the SmartVue current loop inputs. The RTD sensors were mounted in such a way as to measure actual air temperature instead of the heating chamber temperature. This way the thermal time lag of the control loop is minimized.

Actuator changes

The original 120VAC control input ON/OFF solid-state relay was replaced with a 4-20mA current loop proportional phase angle control module to provide variable heating power.

A safety cutout relay was added in series with the AC supply to the heater controls to switch off power should the set safety limit be exceeded.

SmartVue Installation in the Incubator

The SmartVue unit occupies the position of the former mechanical thermostat. The Dycor provided SmartVue template was used to define the cutout outline which was milled on a simple bench milling machine.

Modified Control Panel with SmartVue and Safety Controls

To round up the upgrade, a USB type-A connector was installed to the left next to the safety thermostat knob. This allows the use of a USB memory stick to collect logged data and settings. An Ethernet connector was installed in the back to allow remote control of the chamber.

Dycor's SmartVue Remote application can be used to interact with its graphical virtual interface the same way as an operator directly in front of the unit.

Safety Provisions

Several safety measures exist to protect both the chamber and the living payload. It is critical to protect the living organisms from excessive temperatures. The original safety thermostat was given an empirically calibrated dial to allow setting a safety cutout temperature to an operator set limit.

Calibrated Safety Cutout Control Dial

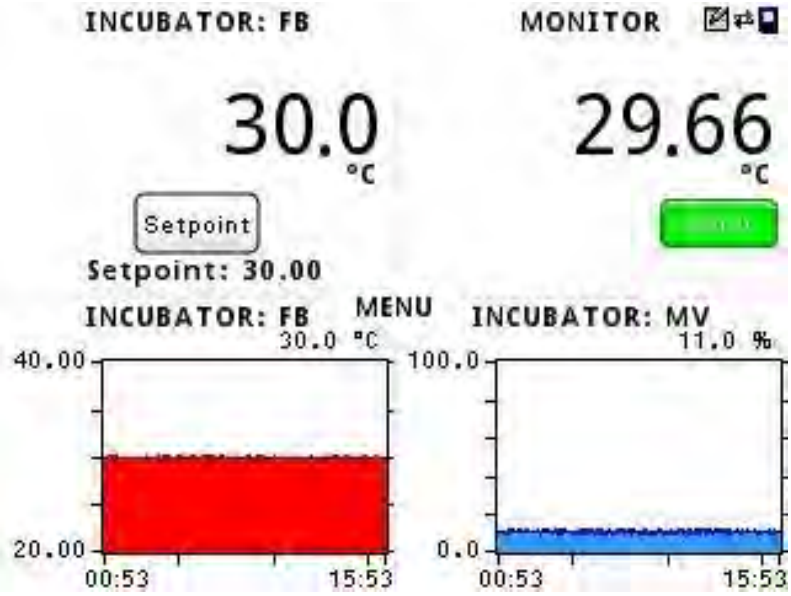
The SmartVue control system features safety provisions as well. Two provided RTD sensors provide temperature input to two processes.

- The Control Loop process is used to maintain the set point temperature.
- The second sensor is monitored by another process to monitor the maximum heated air temperature to prevent overheated air entering the chamber. Should the heated air exceed this limit for some reason, a latching relay in series with the heater power control will interrupt the heater power until corrective measures are taken.

Dycor’s SmartVue Remote Software

Figure 6 shows a snapshot of the actual SmartVue control process screen with the SmartVue Remote Software communicating with the SmartVue via the LAN connection. This software can be downloaded freely from the SmartVue website:

(http://www.smartvue.ca/downloads/?subpath=SmartVue%20Remote/)



SmartVue Process Control Screen

Improvements

Because the heated air temperature is used for feedback, a small temperature gradient is present due to the heat losses through the chamber enclosure walls. This gradient can be manually accounted for. It might be possible to measure also the returned air and reduce the gradient to ZERO this way. This method was not chosen due to the risk of overheated air harming the living organisms during the heating process. It was decided to account for this difference manually by adjusting the set point somewhat higher.

Results

Lab Equipment can be a significant capital cost. Procedures and processes within a business that rely on specific hardware can require significant overhauls if that specific hardware needs to be replaced or altered. In this case - the client had regular operations that required the consistency of particular equipment and the repeatability that the equipment offers.

Retrofitting the equipment with Dycor's programmable controllers permitted them to retain the equipment, procedures, and repeatability desired, while adding functionality that made the equipment more capable, and flexible.

Contacting Dycor

It doesn't matter if you're looking for replacement components, sensors, or Controllers, or require assistance with a simple configuration issue with your data logger, Dycor's technical team is here to get you up and running quickly and effectively.

Give us a call or **contact us on-line at www.dycor.com** requesting more information on how we can help you design and implement a data acquisition system that works for you.

Dycor Technologies Inc.

4620 74 Ave NW
Edmonton, AB, Canada
T6B 2K3

Phone: +1.780.486.0091
Fax: +1.780.486.3535
Toll Free: 1-800-663-9267
Email: sales@dycor.com

Disclaimer:

Modifications to electrical equipment should only be performed by qualified personal and organisations to local electrical regulatory requirements.