

Automated Heater Control and Monitoring using LabVIEW and NI ELVIS

R. Jamuna

UG Student,

Instrumentation and control Engineering,
Saranathan college of Engineering,
Trichy, India.

M. Anusha

UG Student

Instrumentation and Control Engineering
Saranathan College of Engineering
Trichy India

J. Bavithra

UG Student

Instrumentation and Control Engineering
Saranathan College of Engineering
Trichy, India.

T. Devashena

Assistant Professor

Instrumentation and Control Engineering
Saranathan College of Engineering
Trichy, India.

Abstract:- Temperature control is a very tedious process that requires lot of care and additional features for ensuring safety. The temperature control of a heater placed inside a cylindrical circulating tank, almost involves all the process parameters to be controlled. LabVIEW is a graphical design software that enables the controlling of temperature of the water in the cylindrical tank model ,by operating the heater.NI ELVIS provides a platform for the effective control of hot water temperature in such a way that the temperature of the tank follows the set point ranges. The major challenge in the project is to control the operation of the heater, for the temperature to be within the specified range. The temperature sensor output is fed to LabVIEW program and this parameter is programmed to get through many comparisons .The heater in the circulating tank is operated through ,ELVIS module compatible micro-relay and relay circuits ,by using the voltage generated from the module through the program.

The process variable, controller output, set point ranges are clearly displayed using charts and the data is recorded for future analysis in the form of excel sheets.

The heater status is also made wireless, using NI-Elvis and NIC card module. The wireless interface enables remote access to the system and to monitor the process parameters of the process station from any place that is away from the field , in industries.

Keywords: Temperature, circulating tank, NI ELVIS module, heater, remote access control.

I INTRODUCTION:

LabVIEW is a virtual designing software that aims at introducing automation projects using efficient data flow programming models and methods. It is expanded as ,Laboratory Virtual Instrument Engineering Workbench. It is a system design software developed by National Instruments. It is actually a graphical language programming software that supports cross platform operating systems. Data acquisition, Test Automation, Embedded design , Industrial design and signal processing can be efficiently done using LabVIEW software. Temperature process is a very slow process .Especially in

case of kilns, boilers, circulating tank with high capacity have slow temperature loops. It is non-linear and time varying process. Depending upon the input and output of the system, the temperature control method varies. Even, the fuel changes can change the process parameters drastically.

NI ELVIS (National Instruments Educational Laboratory Virtual Instrumentation Suite) is a hands-on design and prototyping platform that comprises of 12 commonly used instruments – including oscilloscope, multimeter, function generator, bode analyzer etc., into a compact form. It can be connected to personal computer using USB connection. Any analog (voltage and current) and digital signal can be acquired and generated using the connection pins in the prototyping board of NI ELVIS. It provides flexible method for connecting hardware with software and hence enable flexible automation in slow process like temperature control.

NI myRIO provides a platform for remote wireless access to the process station to the real time industrial software LabVIEW.

II PROCESS IMPLEMENTATION:

The Temperature of water in the tank is maintained to be within the specified range using on off controller implementation in LabVIEW software. The temperature sensor used in the system is a two wire RTD Pt100.This sensor outputs resistance change with respect to the temperature changes in the output. For the conversion Resistance to voltage, Wheatstone bridge circuit is used. Since ,NI ELVIS accepts signal in the form of voltage or current, the effective conversion of Resistance to voltage is done in ELVIS prototyping Board. The corresponding voltage is acquired through ELVIS to LabVIEW.

In the LabVIEW software, the acquired voltage is calibrated for its conversion to temperature in degree Celsius. The temperature conversion enables user friendliness while involving comparisons with the set point in the LabVIEW program.

The Temperature is given to a case structure in LabVIEW program and made for comparisons. Firstly, it is compared with the lower limit to have reached a difference of zero. On reaching lower limit ,it is hen compared with upper limit to have reached a difference of zero. On reaching the upper limit, the current temperature is compared with the lower limit to have a difference of zero. If the case structure follows false condition, then the 5volts output is generated from ELVIS ,which activates a micro-relay and then the 12v relay that operates the 230volts 300watt ac heater load in the circulating tank. The temperature gets maintained in the user defined specified range.

III RTD CALIBRATION:

NI ELVIS accepts either voltage or current at its analog input channels for its efficient acquiring of signals. The voltage limits are -10volts to +10volts.similarly,NI ELVIS can handle current in the ranges of -10mA to +10mA.It has totally 8 differential or 16 single ended channels at its analog input side. The Wheatstone bridge connection implemented in NI ELVIS prototyping board is shown in figure 1 below.

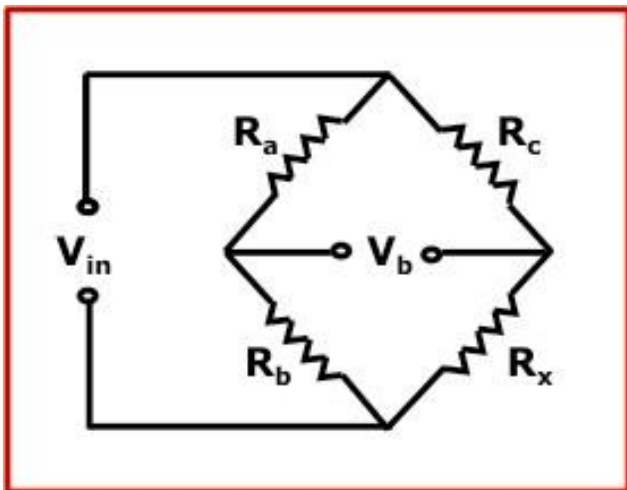


FIGURE 1 Wheatstone Bridge

Since RTD provides temperature changes in terms of resistance, it cannot be directly acquired either as temperature or as resistance. So, Wheatstone bridge is implemented to convert the corresponding resistance changes to voltage. The input voltage $V_{in}=5$ volts and the resistances $R_a=R_b=R_c=1$ kilo ohm. But, still the voltage has to be displayed in the program in terms of temperature(in degree Celsius).Hence, it is calibrated. V_b ia the voltage that is acquired using NI ELVIS to LabVIEW program.The Temperature and its corresponding voltage in Wheatstone bridge are tabulated and the relation between them is used to convert back to temperature.

Time(secs)	Temperature($^{\circ}$ C)	Voltage (volts)
0	30	1.91
10	30	1.91
20	30	1.91
30	31	1.91
40	31	1.91
50	31	1.91
60	31	1.91
70	32	1.91
80	32	1.90
90	35	1.90
100	36	1.90
110	37	1.90
120	38	1.90
130	40	1.89
140	43	1.89
150	45	1.89
160	46	1.88
170	48	1.88
180	50	1.88
190	52	1.88
200	53	1.87
210	55	1.87
220	58	1.87
230	59	1.87
240	60	1.86
250	63	1.86
260	65	1.86
270	67	1.86
280	69	1.86
290	70	1.85
300	72	1.84
310	74	1.84
320	80	1.80
330	80	1.80

TABLE 1 CalibrationTable

The Readings considered for effective calibration are mentioned in table 1.By using the straight line equation, the voltage versus temperature calibration was completed successfully.

IV LabVIEW PROGRAM IMPLEMENTATION:

LabVIEW is a highly industrial and real time oriented software. It allows programming commands of C, Scilab to be interfaced to it. The Temperature is compared with the user defined set point (in terms of temperature).There exists two cases for its operation. Firstly, if the temperature is less than the set point, then a true value is returned to the case structure, in which 5volts is programmed to be generated.

This 5 volts is fed as input to a relay system. But, since the load is high power ac load, it cannot be driven directly.NI ELVIS generates 10volts at the maximum which does not effectively operate ac relays with isolation. So, it is activated using micro-relay that gets constant supply. But it provides this supply to relay only when it receives 5 volts excitation from ELVIS. The DAQ Assistant Express VI that is used for acquiring and generating is shown in figure 2 below.



FIGURE 2 DAQ Assistant

Suppose, if the temperature is greater than set point then it turns on relay system by providing zero volts to it or no supply to it through program. The write to measurement file Express VI involves in providing a spreadsheet that shows the temperature with respect to time in excel sheet. This allows monitoring more easy and efficient.

V CONCLUSION:

The major advantages of process Implementation in LabVIEW are its parallel programming feature, interfacing to devices, easy compilation. It also has large library features and future scope of project can be expanded in terms of alert messages and mails, easily using LabVIEW and its prototyping boards. The purpose of on/off control is to keep a given physical variable, e.g. the ambient temperature, within certain limits .

Temperature process is a slow process that requires keen attention in its controlling and monitoring. This paper provides a basic platform, in which the process is controlled automatically using LabVIEW software. Thermostats and pressure controls for on/off control are two-position regulators where the manipulated variable can only lead to two conditions: on or off.

Using LabVIEW software, the sensor interfacing and the automated control and monitoring is implemented efficiently.

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