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Design of PC-based system for monitoring and control of a thermal process using LabVIEW

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Abstract

Pc-based using LabVIEW system was developed to monitor and control the temperature of an oven. The RTDPT100 was used as a temperature sensor which offers high accuracy over a wide range from -200 to 850°c. For system switching control we used ON_OFF control algorithm. The system provides a digital readout as well as graphical display for showing system temperature and indicators which indicate system status/progress. National Instruments' labview8.5 software was used for programming. This system improves accuracy, easy to operate and upgrade.

Keywords: LabVIEW, ON-OFF control, temperature sensor

1. Introduction

The advancement of technology always influences the industrial processes. These processes over time have been refined from manually controlled systems to automated computer control systems. This has led to more efficient manufacturing processes with easy operate. The measurement of the physical variables of industrial processes is essential for control and monitor of these processes based on measured variables. Temperature, pressure, flow rate, humidity, etc., are some of the Example of these variables. In this paper, measurement of temperature of oven is designed and implemented based on LabVIEW software, which is one of the versatile software for instrumentation. The system was interfaced through parallel port of personal computer. It is cost affective and reliable system.

2. SYSTEM DESCRIPTION

The block diagram of the Design of PC-based system for monitoring and control of a thermal process using LabVIEW is shown in figure 1. The system hardware consists of a, RDT PT100temparature sensor, signal conditioner circuit, A/D converter of MAX197, PC-with parallel port and LabVIEW software, and other circuit are introduced for blinker and heater system control. This system designed in the range of 0-100°C.

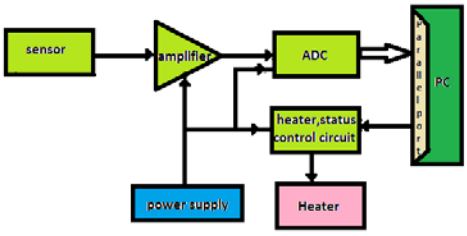

Figure-1 The block diagram of the Design of PC-based system for monitoring and control of a thermal process using LabVIEW.

1.2 Software of the system

The software program which controls the system was developed in National Instruments' Labview8.5. The algorithm steps is listed below.

1) Initialize DAQ system through parallel port
2) Set temperature (ST)
3) Sample the process temperature (PT)
4) Compare ST and PT
5) If ST>PT than continue heating
6) If ST=PT than turn OFF the heater

Figure-2 shows the flow chart for the system.

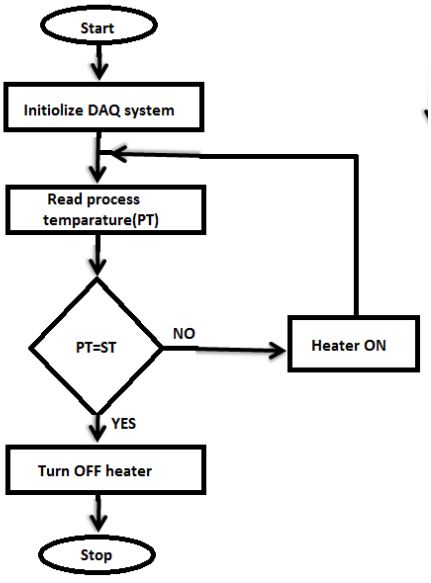

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Figure-2 The flow chart for the system

1.3 The transducer circuit

1.3.1 PT100 temperature sensor

The platinum resistance thermometer PT100 was used as the sensor as shown in figure-3. Which offers high accuracy over a wide temperature range from -200 to 850°C . The most common type (PT100) has a resistance of 100 ohms at 0°C and 138.4 ohms at 100°C. PT100 is the common abbreviation for the most common type of resistance temperature sensor used in industry. Figure-3 shows the PT100 sensor circuitry

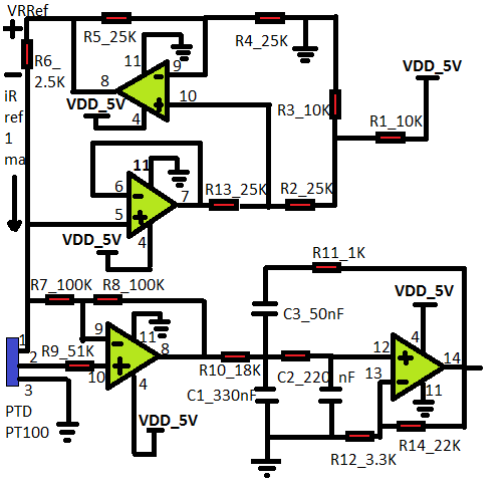

Figure-3 shows the PT100 sensor circuitry

1.3.2 Signal conditioning unit

Any instrumentation measurement system consist of various units starting from sensor to data representation units. Among that signal conditioning is a vital process. This system consist of Amplifiers, Filters, ADC, and DAC etc. The process instrumentation consist of signal conditioning and processing unite for very low frequencies. During study of these signals, noise interference is a major problem and complex. The signal conditioning unit provide amplification, filtering, converting and other processes required to make sensor output suitable for reading by Personal computer.

In the present design we used LM324 as an amplifier for amplifying the temperature sensor signal and the output of the amplifier is given to the Analog to Digital converter. And Sallen-Key Filter was used in signal conditioning unit which gives simplicity in the design, Non-inverting Amplifier (positive Gain), and replication of elements.

In the present study MAX197 Analog to Digital converter used. The device includes an 8-channel multiplexer, 5MHz track/hold, 12-bit A/D converter and 4.096V reference and features a parallel digital interface that connects easily to most PC-parallel port, as well as microprocessors. It is a 28-pin, multi-range (0 to 5v, 0 to 10v, +/- 5v, +/- 10v), data acquisition system that works with only 5V supply. In present design we interfaced MAX197 with PC-Parallel port.

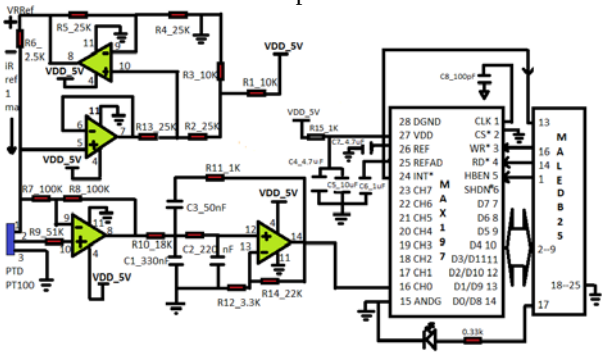

Figure-4 shows the signal conditioning unit of the system.

1.4 Personal computer and LabVIEW software

1.4.1 Personal computer

Computer plays a pivotal role in instrumentation in field of data acquisition, instrument control and data processing. To measure and control any instrument it is to be interfaced with a personal computer. For this we need interface devices like DIOT card, Serial port and parallel ports. Even though DIOT cards fulfils the requirements but it is cost effective. One of the cheap solution is using parallel port as interface device. Parallel port is 25 pin female D-type connecter. Any parallel port effectively consists of three hardware registers –data register (DR) (8 lines, Bi-directional in modern P4 systems), Status registers (SR) (5 lines, input only) and control registers (CR) (4 lines, Bi-directional). In present study, a powerful 32-bit Intel Pentium processor based personal computer is used.

1.4.2 LabVIEW software

LabVIEW is development application software like C/C++, Java, .it is graphical programming language, so called ‘G’ language. It has a back panel where we write programming code in form of icons and front panel which allows indicators and controls for display and control purpose. The programs written in LabVIEW are called “Virtual Instruments” or VI’s due to their instrument related origin. The programs created are portable of the type of machine and operating system [1]. And it has a build in mathematical functions, graphical data display objects and data input objects. LabVIEW has many features some them are, data flow controlled execution, real time debugging features, data base (SQL) interfacing for industrial PLC’s, and add-on

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software packages for specific extension of the program features, etc.

1.5 Control of heater and blinker circuit.

The control circuit is responsible for the actual ON-OFF switching of the heater, the status indicator and the blinker circuit. The circuit is given in figure 5.

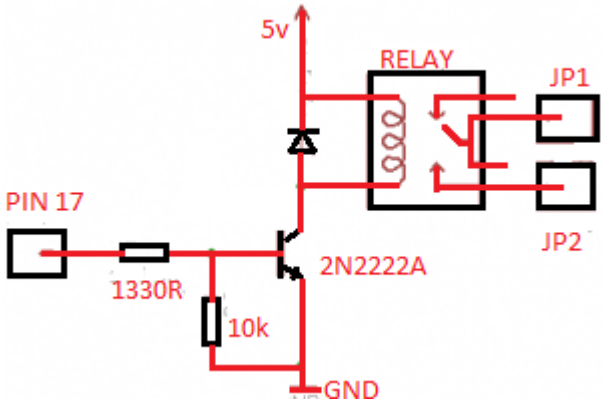

FIGURE-5

2 RESULTS AND DISCUSSION

Hardware was evaluated individually during the development stages and finally integrated all units. Software written in LabVIEW and debugged, all errors found were corrected. The system was tested several times by heating of oven. The system was calibrated and the results compared with standard instruments and we found results are good agreement with standard results.

3 CONCLUSION

The solution has provided a low cost custom built monitoring and controlling system. However as far as the industrial applications are concerned this can be viewed as a low cast, customized system. Thus this solution can be customized to suit any other industrial requirement related to monitoring and controlling provided industrial sensors are in use.

The approach discussed in this paper is novel and has achieved the target to control and monitoring of thermal process using LabVIEW. Hence we can concluded that the required goal of system have been achieved.

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