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Data Acquisition System of Temperature Measurement Using LabVIEW Application

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Abstract— Data Acquisition (DAQ) is widely used in Research and Development, Quality Control, Testing. Data acquisition (DAQ) is a process in which raw transducer signals are converted to computer readable data so that computers can store and manipulate that data. Temperature control system mainly the measuring and even to achieve stable or desired value have big challenge and importance in all sector of industry. This article tries to summarize the recent advancements in data acquisition technology and also explains the utility of LabVIEW software in DAQ applications related to temperature measurement.

Keywords: DAQ, LabVIEW, and Temperature Control.

1. Introduction

Temperature is one of the common controlled and measured by most of the industry. Financial loss can be possible if there is uncertain behavior or some variance in the accuracy of the measurement. In industry thermistor, pyrometer, thermocouple and RTDs are used. So all temperature information are converted into electrical signal and after that desired control method used for further processing. The signal generated by the transducer has a high amount of noise and hence must undergo some signal conditioning and hence signal conditioning circuits are used. The conditioned signal is an analog signal and hence it cannot be stored and processed as data by computers. Additionally, LabVIEW offers a number of wizards that can be used to quickly configure your DAQ devices, computer-based instruments, and applications. Users can modify inputs, operate the application, and view data being updated in real time. The block diagram has a terminal for each control or indicator on the front panel. Values from controls move across the block diagram during VI execution, where they are used in the functions on the diagram and the outcomes are transferred onto other functions or indicators via wires. In LabVIEW, there are many built-in analytical functions that may be utilized to quickly develop programmes to solve complimentary problems. The system's features include data gathering, saving, and display. In the LabVIEW environment, a flexible virtual temperature monitoring system is created. The creation of the LabVIEW block diagram module was simple, adaptable, quick to follow, and straightforward to present. LabVIEW is a piece of software used to construct systems that measure and analyze data. It is typically viewed as a tool for virtual equipment and automation. Essentially, the integration of sensing devices, personal computers (PCs), and data gathering constitutes the overall system (DAQ). Making data acquisition and control software with traditional programming methods can be a laborious process that takes a lot of time so here we design the basic front end panel and sliding mode control of temperature using LabVIEW. Reader can understand easily for the overview on temperature measurement.

2. Data Acquisition for Temperature Control and Measurement

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DAQ (Data Acquisition) is defined as the process of taking a real world signal, it may in the form of voltage or current of any electrical input then it process through the computer for analysis, processing or any manipulation or conditioning or for storage. Signal condition circuit like scaling, amplification, filtering, attenuation, common mode rejection, excitation and linearization so on . All signal conditioning improve the quality of the signal [1] :

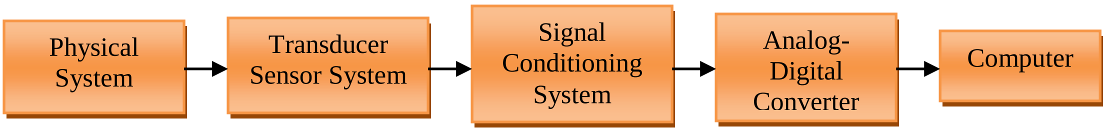

Figure 1. Data Acquisition System

Table 1. Different controller performance [3]

Controller	**Peak Time (*Tp*)**	**Settling Time (*Ts*)**	**Stability**
P	Decrease	Small change	Worse
PI	Increase	Increase	Decrease
PD	Decrease	Decrease	Improve
PID	Decrease	Decrease	Improve

Real time virtual based data acquisition can be possible[2]. Many industry used different controller as per the requirement and their performance which is shown in table 1. These features, including waveform display, channel selection control, parameter measurement and display, waveform storage and playback, were made possible by LabVIEW's graphical programming language and multi-threading technology.

2.1 LabVIEW based Temperature Measurement

Making complex graphical user interfaces (GUIs) [4] and embedded systems is simple with LabVIEW, a programming language and software development environment. It is widely employed in several commercial, scientific, and industrial applications [5]. LabVIEW applications are much more implemented in many industry [6].The official website offers a free download of LabVIEW [7]. Basic front end panel is shown in figure 3 and it's waveform shown in figure 3.

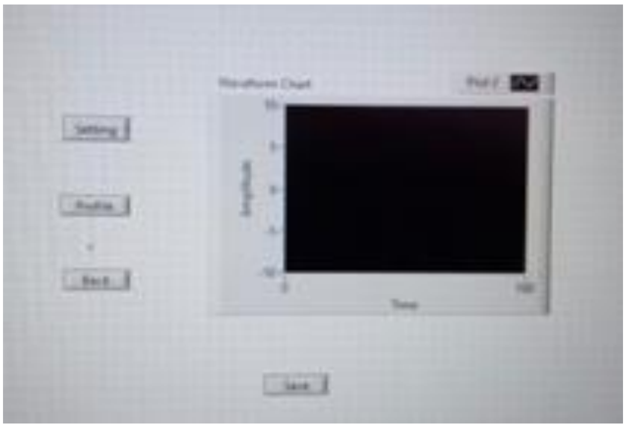

Figure 2. Front end panel

By utilising a number of tools and objects in LabVIEW, a user interface can be created. The front panel is the term for the user interface. To manipulate the front panel items, one can add code using graphical representations of functions [8]. Virtual instruments are LabVIEW programmes (VIs). The front panel, the block diagram, and the icon and connection pane are the three main parts of a VI. To make and run VIs, LabVIEW includes graphical, floating palettes [9]. The Tools, Controls, and Functions palettes are among the three. These palettes can be positioned anywhere on the screen.

Figure 3. Waveform for front end panel

The tools that are shown in the floating Tools palette can be used to create, alter, and debug. Both the block diagram and the front panel contain the Tools palette. A tool is a specific way for the mouse pointer to operate. The cursor icon becomes the tool icon when a tool is selected. To operate and alter front panel and block diagram items, use the provided tools. Place controls and indicators on the front panel using the Controls palette. Only the front panel contains the Controls palette.

To run VIs, LabVIEW uses a dataflow model [10]. When all of a block diagram node's inputs are available, the node executes. Data is supplied to a node's output terminals after its execution is complete, and the output data is passed to system.

2.2 Temperature Control and Measurement

Temperature control can be possible by models like PI, PD, On-Off, PID as per requirement in the industry. The designed system can be controlled by LabVIEW software application. While measuring some parameters need to be noted like which kind of sensor and it's reaction rate with respect to temperature change, the level of environmental constraints [11]. So one must need to choose suitable sensor to look into the above different condition along with cost. Now a days smart home can be possible by proper temperature control [12]. Now a day's LabVIEW based solar air heater monitoring system is used [13]. Temperature simulation can be done by multisim and LabVIEW software [14]. LabVIEW is also very helpful for health care system [15].

3. Result and Discussion

The LabVIEW Data Acquisition library offers VIs to operate National Instruments plug-in DAQ boards, which one can create, modify, and debug using the tools available there. One board can frequently do a number of tasks, including digital-to-analog (D/A) conversion, counter/timer operations, and analog-to-digital (A/D) conversion. Different data acquisition and signal production speeds are supported by each board.

Each DAQ board is also made to work with a particular set of operating systems and hardware. You must take into account the following elements while measuring analogue signals using a DAQ board: mode (single-ended and differential inputs), resolution, range, sample rate, accuracy, and noise.

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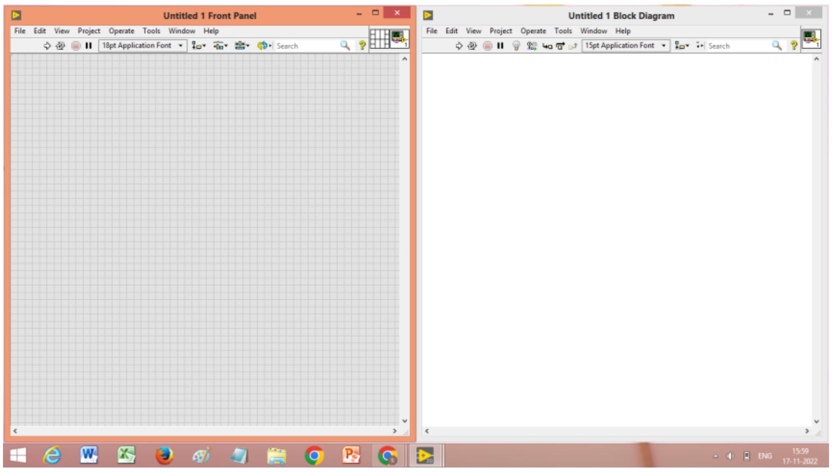

Figure 4. LabVIEW window showing front panel and block diagram

The voltage that the temperature sensor on the DAQ Signal Accessory outputs can be measured using a VI. A voltage proportional to the temperature is produced by the temperature sensor. The DAQ board's Channel 0 has a hard-wired connection to the sensor.VI that outputs voltage in stages of 0.5 V from 0 to 9.5 V. Using a voltmeter, one will gauge the voltage output. Figure 4 represents the basic front panel and figure 5 shows control of temperature. Figure 6 represents for different conditions different temperature indication on the LabVIEW.

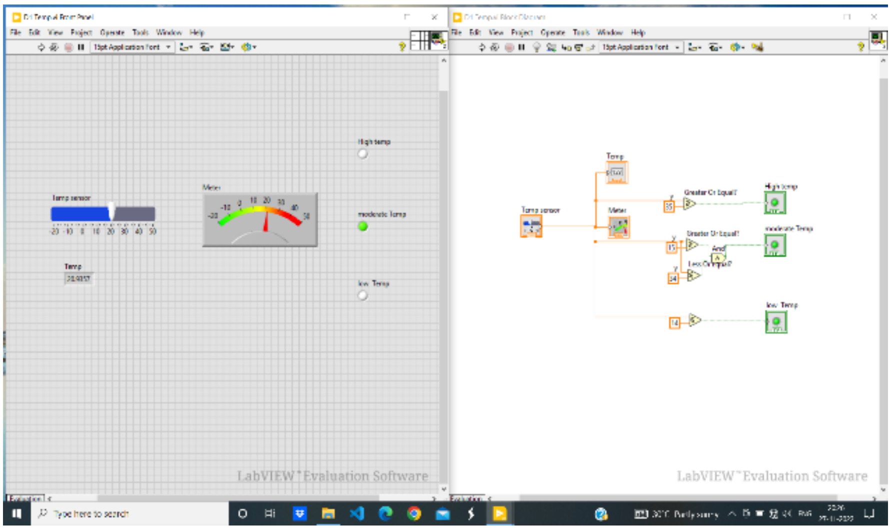

Figure 5. LabVIEW program that control to temperature

Figure 6. LabVIEW program that for low, moderate and high control of temperature

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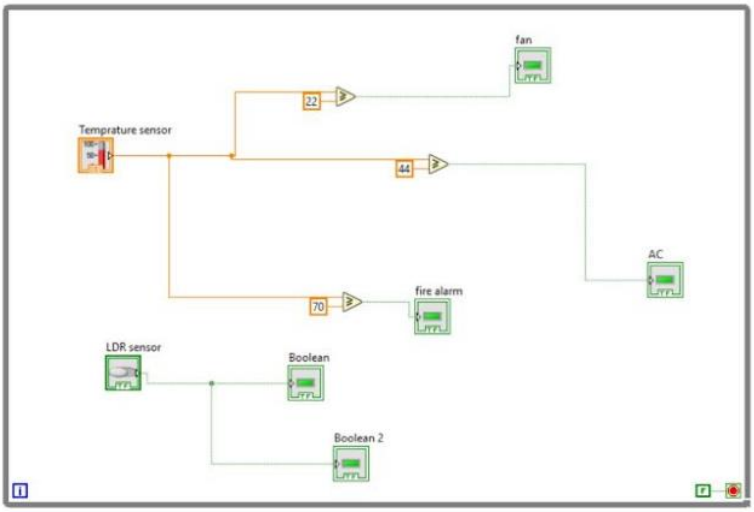

Figure 7. LabVIEW program for room temperature control

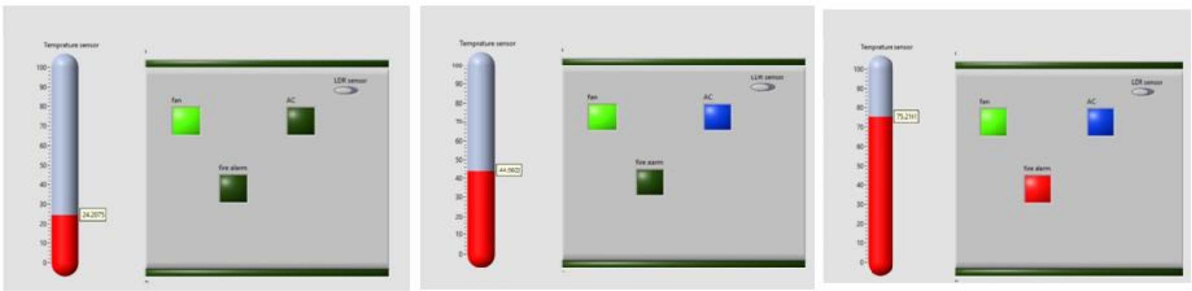

Figure 8. LabVIEW visualization for different temperature

Figure 7 and 8 shows a room temperature control with some logic as if certain temperature in the room the fan must be on and if the temperature rises more then the AC will be on. Figure 8 clearly indicates three different cases according the temperature increases fan, ac and fire alarm blinks.The software LabVIEW DAQ VIs are well organized into subpalettes which is corresponding to the verity type of operation involved—analog output, analog input ,counter operations, or digital I/O.

4. Conclusion

LabVIEW display windows are built from a VI template. The Display Template. Vis is based on the Queued State Machine template in AMC. Every time new data is received from the notifier, the Process Data state is executed.This is where any display code should be place such as channel selection or signal processing (FFT, RMS, etc). If it is important to the display, the data can be checked for continuity so the user is informed if the display is not continuous. This is particularly important to know in cases where signal processing like averaging or filtering is used across multiple data blocks. The LabVIEW graphical programming environment was used to create a genetic algorithm for instrumentation control and optimization. The creation of the LabVIEW block diagram module was simple, adaptable, quick to follow, and straightforward to present. The advantages of LabVIEW's user-friendly interface, vibrant Virtual Instrument panel, and flowing programming style significantly increase the effectiveness of producing VI. LabVIEW is being used more and more frequently in various instrument measuring and controlling sectors. The application examples show that the VI not only makes a multipurpose computer possible, but also saves manual error and complexity during the collection and processing of testing data, hence enhancing the accuracy and repeatability of testing results. The experience demonstrates that creating VIs with LabVIEW also has benefits such as high productivity, a user-friendly interface, simple operation, and extensive function expansion. Here reader can easily understand the use of LabVIEW application with simple temperature measurement.

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