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# Real-Time Monitoring of Industrial Environmental Temperature using LabVIEW

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***ABSTRACT:*** *Graphical System Design applications are the fastest spreading one in the field of industrial environment. Over the decades monitoring of physical parameters in the industrial environment is made easy with various sensors. Several softwares are used to monitor those physical parameters. The objective of the work is to monitor the environmental temperature. The sensors that are used to measure the physical parameters tend to give electrical output either in form of Voltage or Current. In this paper current output is preferred for temperature conversions rather than the voltage output as they tend to drop over the transmission line. The current output of Temperature/Humidity sensor (THD Series) is converted into temperature in degree Celsius. The Real-Time environmental parameters are acquired from Autonics Temperature/Humidity sensor using NI Compact DAQ 9174(cDAQ). A Graphical approach is developed in LabVIEW platform to monitor the environmental temperature with the help of a PC.*

***Keywords:*** *Temperature, Data Acquisition, LabVIEW. cDAQ9174.*

## I. INTRODUCTION

LabVIEW (Laboratory Virtual Instrumentation Engineering Workbench) is a Graphical programming language developed by National Instruments. Unlike the sequence (or) Text based programming language it uses graphical icons to develop algorithms. LabVIEW is a powerful tool that includes several modules to acquire data from outside word. It helps to process those acquired data and to represent them graphically [5]. The graphical programs are called Virtual Instruments (VI). It has two sections namely Block diagram and Front panel. Entire logical function is built and wired in the Block diagram section. The controls and indicators are accommodated by the front panel for control and monitoring purposes. The user can interface with the front panel objects by changing the inputs dynamically during the execution [6].

## II. LITERATURE SURVEY

Generally temperature in industries is measured with respect to the output voltage generated by the sensing system [1]. The drop in voltage level over the wires reduces the reliability. In this work current output instead of voltage is preferred which doesn't affect the system reliability. The DC value obtained is converted into temperature using simple conversion technique. This technique is able to adopt with environmental changes without compromise in its accuracy.

Every industrial plant suffers with the measurement and monitoring of process variables. Several process variables vary widely with respect to time. Being an important parameter the industrial temperature put us a challenge in precise measurement. Many methods have emerged to overcome the challenges that impact the reliability in measurement and monitoring system. For the continuous measurement of temperature and other process variables the industry has to go with a specific product for each variable. Such products increase the system complexity and require proper maintenance. But the Real-Time monitoring of Industrial Environmental System makes the task of measuring and monitoring temperature easy.

## II. DATA ACQUISITION SYSTEM

Data Acquisition is the process of acquiring environmental parameters such as Temperature, Pressure, Acceleration, Voltage, Current and Humidity with a computer using Data Acquisition device. DAQ devices are of two types namely General purpose DAQ and Special purpose DAQ. We can acquire several physical parameters with single General purpose DAQ where as special purpose DAQ devices acquire only dedicated parameters for which they are designed for. They can be interfaced with PC through several ways as well. The General purpose NI compact DAQ 9174 is interfaced with PC via USB. The NI cDAQ has four slots for input and output modules. The input modules are used to acquire data from outside world. The output modules are used to generate signals to outside world. The input module NI 9208 is used to acquire temperature. It has 16 analog current input channels. This input module has high sampling rate of 500 Samples per second with 24 bit resolution [3].


Fig 1: Block diagram of Data acquisition system

## II. TEMPERATURE/HUMIDITY SENSOR (THD SERIES)

Environmental temperature is measured with help of an Autonics TEMPERATURE/HUMIDITY CONTROLLER (THD Series). It has 7segment LED display with 3 digits to display temperature and humidity. It has fixed sampling period of 0.5 seconds [4]. The excitation voltage required for THD sensor is 24VDC. It produces Direct Current and Voltage as outputs. The THD Series sensor senses the environmental temperature and gives an output current corresponding to the sensed temperature. The output current of sensor is linearly proportional to temperature and able to operate in the range -19.9ºC to +60.00ºC with an accuracy of ± 0.8ºC. The Direct current output of THD sensor ranges from 4-20mA that can be transmitted to other devices for further processing [4]. At -19.9$^0$C the sensor produces 4mA DC output. At 60$^0$C the sensor produces 20mA DC output. The block diagram of data acquisition system is shown Fig.1.

## IV.FUNCTIONAL MODELING

The proposed design has been developed to obtain the sensor output and to display the corresponding room temperature (°C). The modeling is done with help of LabVIEW in which the order of execution depends on the dataflow at the nodes. The pin details of THD sensor is shown in Fig 2. For temperature, the output of the THD sensor at pin no.3 (Black) is connected to the pin A0 of the Analog input module 9208 which is connected with cDAQ 9174 and pin number 2(Blue) is connected to ground of NI 9208. In the very first step NI cDAQ is initialized. From the cDAQ resource by using NI DAQ assistant express VI the temperature in terms of current can be measured. The THD sensor operates in linear way where the sensed temperature and output current are directly proportional to each other. The linearity of the sensor over the entire range is observed. The results are used to form a look up table from which the relationship between temperature and output current is determined

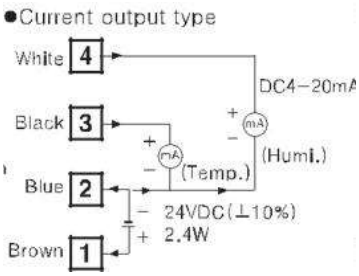


Fig 2: Pin details of THD sensor

and shown in Fig. 3. The observed current values are plotted over temperature and the slope equation is calculated. The obtained slope equation is used to convert the current into corresponding $^0$C.

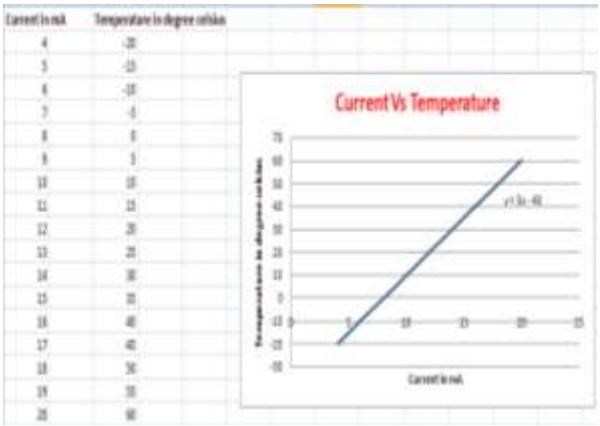


Fig 3: Current Vs Temperature plot

Formula node function is used to implement the slope equation in LabVIEW. The output current of the DAQ
Assistant is fed into the formula node and its output is temperature in $^0$C shown in Fig 4.

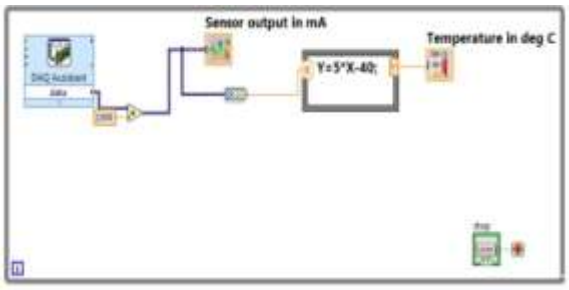


Fig 4: Block diagram of Temperature Monitoring System

## VI. BLOCK DIAGRAM OF MONITORING SYSTEM

Once the Express VI (DAQ Assistant) is placed on the block diagram, the DAQ Assistant gives option to create a new task. For this measurement system acquiring option and current measurement is chosen to indicate a sensing range of 4mA to 20mA.The sample rate chosen is "one sample on demand" [2]. For continuous measurement of temperature the DAQ Assistant Express VI is placed inside the while loop. The DAQ Assistant express VI does the task of acquiring data in a format which is specified in configuration window.

Indicators in front panel appears in modern, classic or system styles. The modern style indicators are used. Many front panel objects have a wide range of color appearances. The meter and thermometer are picked from the numeric under the controls palette [5]. The meter displays the output of the DAQ express VI (Sensor output in mA). The thermometer indicates temperature in °C.

In LabVIEW several data types such as numeric, Boolean, array, string and dynamic are available. The output of the DAQ express VI is of dynamic data type. It has to be converted into numeric data type for further operations. For this, "convert from dynamic data" icon is placed in block diagram which is available in functions palette [6]. It converts the dynamic data type to numeric for use with other VIs and functions.

Formula Node evaluates mathematical formulas and expressions on the block diagram [7]. The input and output for the expression written inside the node is assigned using add input/add output option. In the block diagram shown in Fig.4 the variable 'Y' is the output (temperature in °C) and variable 'X' is the input (current in mA). The inputs and outputs have to be assigned a name as it is in the expression because the formula node is case sensitive.

## VII. TEST RESULTS OF MONITORING SYSTEM

The temperature is acquired using NI cDAQ and the user interface is designed in LabVIEW. The hardware setup to monitor industrial environmental temperature is shown in Fig 5.The front panel in which the sensor output and the sensed temperature are displayed graphically in Fig 6.

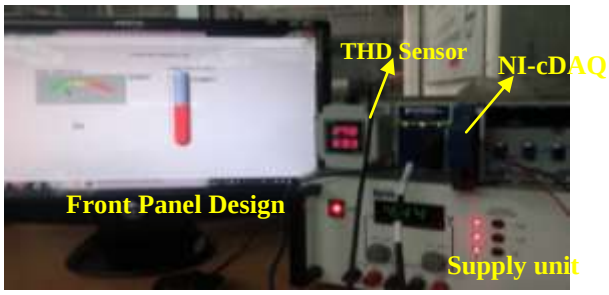


Fig 5: Hardware setup of monitoring system

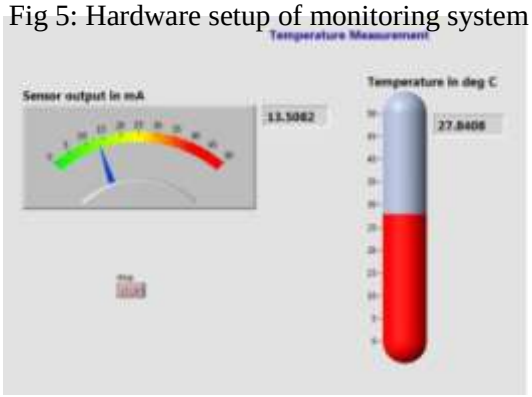


Fig 6: Front Panel design of monitoring system

## VIII. CONCLUSION

The Real-Time monitoring system is developed in Graphical System Design. The current output of the THD sensor is preferred over voltage outputs to avoid the transmission loses. We have proposed an effective conversion method to convert Direct Current (mA) to temperature (°C). This system helps to measure and monitor the environmental temperature continuously in industries.

This work can be extended to access and control the monitoring system from a remote location with web publishing tool of LabVIEW. The temperature changes in the industries over time can be logged into a database in a sorted manner with a time stamp. This system will be upgraded to retrieve the stored data anytime in future.

## REFERENCES

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