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Temperature Data Acquisition using LabVIEW

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***Abstract*—** Temperature data acquisition is an important aspect of various industrial, scientific, and research applications. LabVIEW is a popular platform for acquiring and processing data from different sensors, including temperature sensors. This paper presents an abstract on temperature data acquisition using LabVIEW.

The temperature data acquisition system includes a temperature sensor, signal conditioning circuit, data acquisition module, LabVIEW software, and a computer. The temperature sensor is used to measure the temperature of the object or environment, and the signal conditioning circuit is used to amplify and filter the signal before it is sent to the data acquisition module. The data acquisition module converts the analog signal into a digital signal that can be processed by the LabVIEW software.The LabVIEW software is used to acquire, analyze, and visualize the temperature data. It provides a user-friendly interface for configuring the data acquisition system, selecting the appropriate measurement parameters, and displaying the acquired data in real-time. The LabVIEW software also provides advanced features for processing the temperature data, including filtering, averaging, and statistical analysis.

***Keywords*—** LabVIEW, NI- National Instrument, PID, temperature data acquisition.

I. INTRODUCTION

According to recent research conducted till date, it has been observed that Data Acquisition System using LabVIEW is widely used due to its simplicity, accuracy and customization according to requirement. The main components discussed are sensors, data acquisition hardware and a software tool LabVIEW installed in a computer. Data acquisition is simply a process of sampling signals that measure real world physical parameter and convert these resulting samples into digital numeric values that is manipulated by a computer. The proposed data acquisition and monitoring system makes a variety of measurements that require signal conditioning before the raw signal can be digitized by the data acquisition system. Signal conditioning handles the conversion of current, pressure, and temperature to voltages. Physical variable measurement, storing value, to monitor the physical variable, transmission of the data to a particular field over a network are one of the primary problems in the engineering domains. Therefore for the above mentioned tasks, a dedicated measurement, data acquisition (DAQ) and data logging system has to be developed. But there are some difficulties which affect the system design, these ca be sampling rate of DAQ, number of input and output channels of DAQ, system's voltage and current rating and speed of execution are some factors. LabVIEW (Laboratory Instrument Engineering Workbench) software developed by National Instruments (NI), is used for data logging. It is a design platform which can be used to design a complete system with hardware and software integration using virtual programming language. It uses a graphical language which consists of a front panel and a block diagram. LabVIEW is widely used across the globe both in industry and academia to develop reconfigurable system for data acquisition, measurement and testing. The most common non-electrical quantity measured is the temperature. They have wide variety due to the wide range of temperature to be measured, and the accuracy with which it measures. Even in the field of biomedical data acquisition and LabVIEW plays a major role.

II. LITERATURE SURVEY

Temperature DATA acquisition using LabVIEW has gained significant attention in various RESEARCH AREAS.

A. This paper provides an overview of a facility with numerous boilers' data collecting, data logging, and supervisory control systems. data gathering, logging, and supervision. The fundamental building blocks of plant automation are controls. This study uses a factory with many boilers as a case study where various boiler process characteristics must be collected from the field and tracked. The data of the process variables needs to be logged in a database for future analysis and supervisory control. The process is simulated by a LabVIEW-based data logging and supervisory control programme, and the generated data is entered in the database with the appropriate indication of the condition of the process variable.

B. The design and implementation of labs and course projects using LabVIEW are covered in this paper in a course in instrumentation. The pedagogical challenge is to use LabVIEW to improve students' understanding of digital communication.The laboratory sessions made heavy use of LabVIEW, which helped students become more prepared for their course projects. The students' exposure to virtual instrumentation, data gathering, Modbus communication, and basic closed-loop control was the goal of two course projects. In one experiment, a brushed dc permanent magnet motor was instrumented and controlled; in the other, a small temperature chamber was instrumented and controlled. Students controlled one computer, acting as a Modbus slave, to measure the temperature or motor speed within the chamber and to turn on and off the motor or lightbulbs. The measurements are read by a different computer acting as a Modbus master over RS-485 wires, the measurements are compared to the set points, control decisions are formed, and the commands are transferred to the Modbus slave for actuation. Data from student surveys are used to evaluate how well students learn.

C. Since self-made or commercial measuring instruments are frequently used in scientific research, unique and adaptable control and data collecting methods are a vital tool for measurements. In many cases, software that is purchased along with the instruments is not appropriate for research applications, which demand clear processes with great precision and reproducibility. Commercially viable programming solutions are either not offered or too expensive.This work describes the automation and adaption of a microcalorimeter of the Calvet type for high temperatures. It enabled us to carry out programmable drop calorimetry at minimal cost, without the need for specialised electronics or programming knowledge, with automated sample additions under controlled environment and temperature.decision-making and sending commands to the Modbus It enabled us to carry out programmable drop calorimetry at minimal cost, without the need for specialised electronics or programming knowledge, with automated sample additions under controlled environment and temperature. Using the programme Laboratory Virtual Instrument Engineering Workbench (LabView, National Instruments), we were able to combine many instruments for measuring and controlling via their communication interfaces (IEEE, I/O-port). The programme operates under Windows 98 on a standard Pentium-PC. It enabled us to create user interfaces for entering control parameters, monitoring ongoing measurements, and importing collected data into National Instruments' HiQ assessment programme.

D. Technology has developed so much in the modern era that it can be highly helpful for residential needs. We can govern our daily lives because our home is the centre of our family actions utilising a technical system. Our way of life is made easier and simpler by automating household tasks. A smart home is a home with a smart control system. The electric appliances and security system are controlled by the control system, which is constructed utilising information technology. The smart home is a product of ongoing technological progress and will continue to alter as technology develops. In this essay, we've discussed a smart home feature called a sample home environment monitor and control system. Software called LabVIEW has been used to implement this capability. The system that was designed can keep an eye on the temperature as well as PIR and magnetic door sensors and LDR for family security. Additionally, the system has an internet connection, allowing it to function as a remote system and be managed from any location in the world. This paper describes a multi-platform control system for home automation's hardware implementation. The strategy combines software and physical technologies. The test results show that this system can be used with ease for applications related to smart homes.

E. Laboratory Virtual Instrument, or LabVIEW as a graphical programming language, Engineering Workbench) is becoming more and more popular, especially for data measuring and acquiring. This is because a wide range of data acquisition cards and measurement systems can be supported by LabVIEW, and since programming complex software is relatively simple. LabVIEW can be used to monitor and analyse vibration signals, Predictive maintenance is implemented and faults are found by analysing and monitoring the signal. This paper discusses a data collecting and analysis method based on LabVIEW that was created specifically for vibration monitoring and utilised with vibration fault simulation systems (VFSS). An intuitive data acquisition interface is provided through online representations of the vibration signal's time and frequency domain.

F. This paper details the design of a multi-channel, automated, low-cost data logging system for meteorological applications. Real-time data on various meteorological variables, including the ambient temperature, barometric pressure, altitude, light intensity, and relative humidity, is collected and stored in a database for later use. The system is created using LabVIEW and an ATmega328P microprocessor. The PC-based system has undergone testing and functions successfully.

G. Due to their superior particular stiffness and specific strength qualities, polymer composite materials are the most sought-after materials for aeronautical applications.However, the combined impacts of temperature and humidity can damage these materials. A crucial step in the qualification process for composites is the close monitoring and control of these two parameters in an environmental test chamber for a certain amount of time to mimic the service conditions on the material. At the CSIR-NAL Environmental Test Facility, computer-based data acquisition was previously only possible for data acquisition; however, for control activities, the operator had to physically walk to access the controller and provide the appropriate change in inputs. The development and application of a LabVIEW-based software for monitoring and controlling the temperature and humidity in the environmental test chamber has successfully overcome the constraints. In addition to using the controller itself as a DAQ device to facilitate control and functionality including data gathering, storage, retrieval, and presentation through LabVIEW software, this solution has eliminated the use of the existing DAQ and retransmission module hardware. Additionally, the operator no longer needs to move physically in order to access the controller. This paper describes the creation of a LabVIEW-based closed loop control algorithm and data gathering mechanism. The temperature and humidity in the environmental test chamber have been monitored and controlled by the LabView using

an iTool Modbus Open Platform Communication (OPC) server. The environmental conditioning process is now more effective and economical thanks to the creative and new controller. When compared to the accuracy of the old controller, which was 2℃ and 3% RH, the newly created ETC's accuracy is 0.5℃ for temperature and 1% RH for humidity.

H. In this work, the data acquisition (DAQ) system was created by researching and using the DAQmx driver, which is based on a virtual instrument. The system is capable of processing and acquiring temperature and voltage signals. K type thermocouple sensor, high-accuracy thermocouple measurements module NI SCXI-1102, and high-speed data collection module NI PXI-6251 were used for temperature acquisition. Noise generation and high-speed data acquisition module NI PXI-6289 were used for voltage acquisition. The programme used as the development platform is LabVIEW8.6. The outcomes of the simulation demonstrate that the hardware configuration is realistic and that the interface is attractive and simple to use.

I. The purpose of this study is to design a straightforward real-time remote data collecting system for process or system state monitoring. For monitoring physical parameters and communicating the collected data to the remote operator, a low-cost data capture card is used. When the light intensity is less than 120 Lux, a dark environment condition is detected, and an external light source circuit is turned on or off at this time. Based on the collected temperature data, the fan's PWM speed is controlled. The major goal of this work is to build a framework for continuous information gathering and sharing from the virtual LabVIEW environment using an Android tablet and over the internet. The host computer's hard drive has an MS Excel database file where the acquired data values are also continually logged and saved for later analysis.

J. Environmental data distribution is becoming more and more significant over time. Real-time environmental monitoring helps us find sites that are ideal for manufacturing, agriculture, and other uses. The data acquisition approach in this article is implemented using an Arduino-UNO microcontroller-based board, which also interfaces analogue and digital sensors. Real-time monitoring of temperature, humidity, light intensity, and gas concentration has been combined with simultaneous calculation of dew point. To give the end user the necessary user interface, LabView 2015 is used. It facilitates quick and efficient situational awareness. Additionally, this system offers data for additional processing and for obtaining the desired outcomes. The system is effective for monitoring living environments as well as industrial and agricultural environments. Wi-Fi is utilised to transmit data that is kept in a cloud account for the purpose of an independent weather station that is standalone. Anywhere in the world, this data can be applied for many objectives.

K. The I-V and P-V curves of solar modules are monitored and processed using a low-cost, straightforward technique that is presented and discussed in this work. Utilising the LabVIEW (Laboratory Virtual Instrument Engineering Workbench) interface, this curve must be traced. Electrical variables (voltage, current, and power) are displayed in real time by the built-in LabVIEW programme on specialised graph panes. For any selected panel, the exact current versus voltage (I-V) and power versus voltage (P-V) characteristics are measured, presented, and stored. The suggested method adds the ability to interface a digital multimeter (DMM) with LabVIEW and integrate it into a data processing and data collecting programme. The user has the option to see and capture data in real time as a chart, table, or file (.lvm). A personal computer running LabVIEW software, two DMMs, a solar module, and a variable resistive load make up the entire system. This document can also be used to explore future research ideas in the field of PV system load analysis.

L. The wireless sensor network is developing into a technology with tremendous potential for a number of uses. Despite advances in smart sensing technology, problems with system integration, sensor miniaturisation, and particularly low-power sensors interface circuitry design continue to pose significant technical difficulties. The prototype of a smart, low-power wearable device that can be used for environmental monitoring is described in this work. An assortment of sensors are used by the wearable system, which is wired to a central processing unit with firmware for continuous monitoring. A Graphical User Interface (GUI) created in LabVIEW was used to perform the data collecting process through Bluetooth. For convenience of use and mobility, this system will also be interfaced with an Android device. The purpose of this work is to demonstrate fundamental ideas regarding smart sensing in the context of wearable systems, Bluetooth connection, data capture, and mobile computing.

III. Tables and Figures:

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Sr. No.	Authors	Paper Name	Remarks
1.	S. Padhee and Y. Singh	Data logging and supervisory control of process using LabVIEW," IEEE Technology Students	A data acquisition, data logging and supervisory system is designed for the boilers in LabVIEW. The program monitors the normal operation of the boiler conditions and calculates it in the database, based on which the operator can change the set point of the temperature. The transducers gave the output based on the actual temperature in voltage. The SCADA system was interfaced with the software to show the visible changes in the level and temperature with real time.
2.	W. Zhan, J. R. Porter and J. A. Morgan	Experiential Learning of Digital Communication Using LabVIEW	To provide students a hand on experience in LabVIEW, the motor control system and a temperature control system was developed. The temperature control system was developed to monitor the temperature of their own built module. The lightbulbs inside it were used to increase the temperature and a fan was used as a cooling component. The motor control board drives the motor with a PWM signal and would read the encoder signal which was used to measure speed.
3.	H. Flandorfer, F. Gehringer, E. Hayer	Individual solutions for control and data acquisition with the PC	In the software, the data for time and voltage of the thermopiles as well as temperature data of the Calvet calorimeter is recorded. Using the temperature values the enthalpies of the liquid is measured at a specific value.
4.	P. Kumar	Design and implementation of Smart Home control using LabVIEW	A smart home system has been developed where the system can control the door movement, light on-off system.
5.	A. Gani and M. J. E. Salami	A LabVIEW based data acquisition system for vibration monitoring and analysis	A simple signal processing software was designed to measure and analyze the vibration fault signals.
6.	N. Kashyap and U. C. Pati	Multi channel data acqusition and data logging system for meteorology application	A data acquisition system is developed where the environmental temperature, barometric pressure, altitude, light intensity, and relative humidity are acquired in real time and these are stored in a datasheet for future reference. A RTC clock, to measure the time stamp of those data.
7.	M. S. Murugan, L. Srikanth and V. P. S. Naidu	Design and development of LabVIEW based environmental test chamber controller	A closed loop control algorithm was developed for the control of temperature and humidity parameters in the environmental test chamber (load and unload condition) with the use of Open Platform Communication (OPC) server MODBUS.
8.	S. Ji, Y. Lei and W. Zhang	The design of data acquisition system based on virtual instrument	An acquisition system was developed for Temperature acquisition through K type thermocouple and Voltage acquisition through white noise generation and the values were shown numerically as well as graphically.

9.	N. Khera, H. Gill, G. Dodwani, N. Celly and S. Singh	Remote Condition Monitoring of Real-Time Light Intensity and Temperature Data	The intensity of light and temperature is monitored continuously using LabVIEW software.
10.	V. R. Mutha, N. Kumar and P. Pareek	Real time standalone data acquisition system for environmental data,	Real time data is monitored through the various sensors interfaced in two different manner. One is through the LabVIEW, and the other through the Wi-Fi, where the data is stored in the cloud..
11.	A. K. Gupta, N. S. Chauhan and R. Saxena	Real time I-V and P-V curve tracer using LabVIEW	Current and voltage data is captured and from this power is calculated. Based on those values I-V and P-V curve were plotted graphically in LabVIEW.
12.	M. Serbanescu, V. M. Placinta, O. E. Hutanu and C. Ravariu	Smart, low power, wearable multi-sensor data acquisition system for environmental monitoring	Environmental parameters were successfully measured and plotted graphically at different room temperatures.

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