



TEMPERATURE DATA ACQUISITION SYSTEM USING LABVIEW

¹Aakanksha Patil, ²Vaishnavi Phadtare

¹Student, ²Student

¹Instrumentation Engineer,

¹AISSMS IOIT, Pune, India

Abstract : A crucial component of many industrial, scientific, and research applications is the collecting of temperature data. A well-liked platform for gathering and analysing data from various sensors is LabVIEW. An overview of temperature data acquisition with LabVIEW is provided in this publication. In this work, a PID is used to obtain room temperature. In addition to being simultaneously recorded in a data sheet with respect to time, the values are plotted graphically on the screen. Additionally, LabVIEW is interfaced with several temperature sensors, and a DAQ card is used to monitor the temperature of boiled water. PID provides a seamless software interface by giving a precise temperature reading with little error. As a result, it gives a general overview of how LabVIEW software is used to acquire temperature data. By combining the DAQ card, sensors, PID, and strong programming methods, obtaining temperature is efficient and within less span of time.

IndexTerms - LabVIEW, NI- National Instrument, PID, temperature data acquisition, LM35, RTD, Thermocouple.

I. INTRODUCTION

Research has shown that LabVIEW-based data acquisition systems are frequently utilized because of their accuracy, ease of use, and ability to be customized to meet specific needs. Data collection measures physical parameters in the actual world and transforms the resulting samples into digital values that may be controlled by a computer. One of the fundamental issues in the engineering domains is measuring physical variables, storing values, monitoring the physical variables, and transmitting the data to a specific field over a network. Thus, a specialized measurement, data acquisition (DAQ), and data logging system needs to be created for the aforementioned duties. In this, a PID controller is used with LabVIEW which acquires real time temperature of a particular system or a room. Temperature sensor such as LM35 and Thermocouple (K type) are interfaced with LabVIEW using NI DAQ card which acquires real time temperature. The hardware elements used in the temperature data acquisition system will be thoroughly described in the experimental setup section. The literature survey emphasizes the advantages offered by LabVIEW in temperature data acquisition.

II. LITERATURE SURVEY

In order to learn about the research that has been done in that field, how the technology has developed through time, and other information related to temperature data gathering, numerous publications and articles are studied. Studying the aforementioned enables analysis of numerous components that can connect with LabVIEW, improving the efficiency of temperature data collecting.

This research articles emphasized LabVIEW's benefits in terms of its graphical user interface, seamless connection with various temperature sensors, and real-time data visualization. several studies focused on industrial applications such as, in boilers data acquisition and logging[1], motor control systems[2], data storage[3], smart home system[4], signal processing[5], real time data measurement[6][8][10], OPC server[7], stand-alone data acquisition[9], I-V and P-V curve tracer[11], trends in data[12]. The findings of the literature review demonstrate that LabVIEW-based temperature data collecting systems consistently deliver reliable and accurate results. Overall, the examination of the literature reveals that LabVIEW is a popular and very efficient tool for acquiring temperature data. The reviewed IEEE research papers provide in-depth details on the design elements, hardware integration techniques, and programming paradigms of LabVIEW-based temperature data acquisition systems. In this work, the main contribution is-

- i. Interfaced LM35 and Thermocouple (K type) temperature sensors with LabVIEW using NI DAQ card and acquired real time temperature.
- ii. Interfaced the PID temperature controller with LabVIEW for acquiring real time temperature where the values which are displayed on the PID controller same needs to be visible on the screen in the form of graph as well as numeric value.

III. METHODOLOGY

Fig 1 represents the process flow block diagram. This block diagram represents the temperature data acquisition process. Here sensors such as LM35, Thermocouple (K type) and RTD (mounted in PID) for temperature sensing are used. This temperature data is communicated by 2 different modes of communication:

- i. NI USB-6009 DAQ card.
- ii. BTC-4100 / 7100 / 8100 / 9100 Auto-Tune Fuzzy / PID Process / Temperature Controller.

By using these above modes of communications, the acquired temperature data by sensors is then displayed on the LabVIEW. It plays a vital role in as all the components are interfaced with NI LabVIEW 2022 software for graphical data representation. Here, in the software data is acquired in the form of graphical representation and tabular form. Also, this data can be stored and used for future reference.

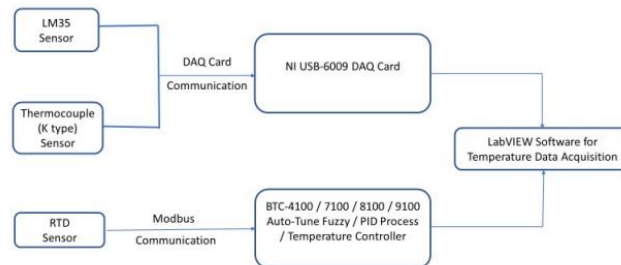


Fig 1: System Block Diagram

3.1 LM35 Temperature Sensor

The LM35 sensor has three pins: VCC, GND, and VOUT. VCC is connected to the positive supply voltage, GND to the ground or 0V reference, and VOUT is the output pin that provides the analog voltage proportional to temperature.

3.2 Thermocouple K type sensor

A thermocouple sensor contains two different metal wires or thermocouple components are linked at one end to form the device.

3.3 RTD in PID

The RTD is placed in the system or process to measure the temperature accurately. It converts temperature into resistance value that can be read and processed by the PID controller as a Setpoint and a Process Variable.

3.4 DAQ Card

It is a physical device that connects to a computer and allows LabVIEW to interact with various sensors, signals, and devices to acquire data. A DAQ card typically consists of analog input (AI), analog output (AO), digital input/output (DIO), and other specialized channels.

For interfacing with LabVIEW software DAQ card of make NI USB -6009 was used along with LM35 and thermocouple temperature sensor.

3.5 PID Controller

BTC-4100 / 7100 / 8100 / 9100 Auto-Tune Fuzzy / PID Process / Temperature Controller was used for interfacing. The process value and set point value are displayed on two bright, simple-to-read 4-digit LED displays in the Fuzzy Logic + PID microprocessor-based controller series.

3.6 LabVIEW

National Instruments (NI) developed LabVIEW. One can build virtual instruments (VIs) using this graphical programming environment for measurement, control and test applications. Due to its simple visual programming language and large array of tools and functionalities, it is widely used. The virtual instrument (VI), has two primary parts: the front panel and the block diagram, is the central idea of LabVIEW. It has numerous controls, such as buttons, knobs, graphs, and displays, as well as indicators, such as displays and graphs.

For this work, LabVIEW 2022 software is used for interfacing LM35 sensor, Thermocouple sensor and PID temperature controller.

IV. EXPERIMENTATION

In this section, the setup of the sensors and PID controller is discussed.

4.1 Interfacing of PID Temperature controller

In LabVIEW 2022 software which consists of the Front Panel the Block Diagram. It contains of following tabs:

4.1.1 Login/Main Screen

The Login/Main Screen includes User type, Username, and Password. The admin and operator have access to the Usertype tab. If the administrator want to access the screen, he or she will select the admin tab in the Usertype and login using the username and password. The operator will go through the same procedure. The purpose behind developing this screen is for security reasons

thus two security levels were created i.e. admin and operator type, where both have their individual login credentials. By implementing this method the privacy and data security is been taken care off.

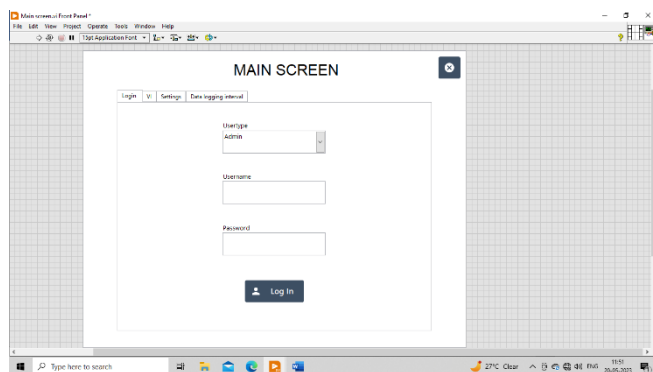


Fig 3: Front Panel of Login/Main Screen

In main screen VI run mode, the DAQ VI gets dynamically called. This main VI has login screen which limits the access of user to the software.

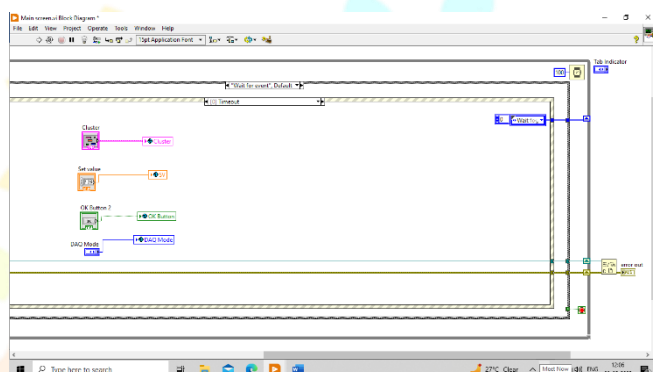


Fig 4: Block Diagram of Login/Main Screen

4.1.2 VI screen

Once the operator logs in, VI screen pops up. This screen consists of Access tab, Settings screen, Test Screen and Report tab.

4.1.2.1 Access tab Front Panel

The built panel of user access control gives user based access to the software. Each new user have to register in the user data by giving a unique username and password. This will maintain the security level of the software and hence will result into good privacy of data.

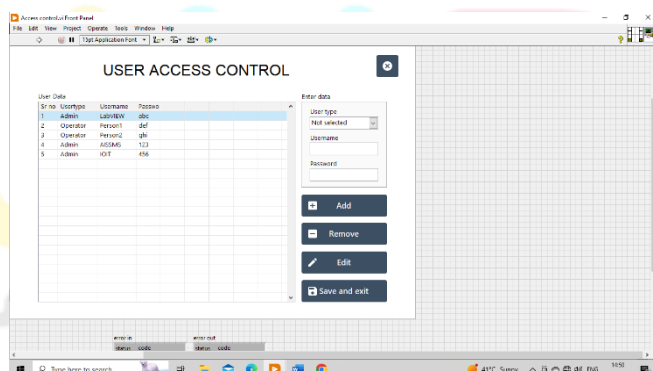


Fig 5: Access Control Screen Front Panel

The username and password is stored in the user access control where one can edit the data accordingly.

4.1.3 History screen

This VI will read the values generated from the test screen and will store those values accordingly. These values can be used for future reference.

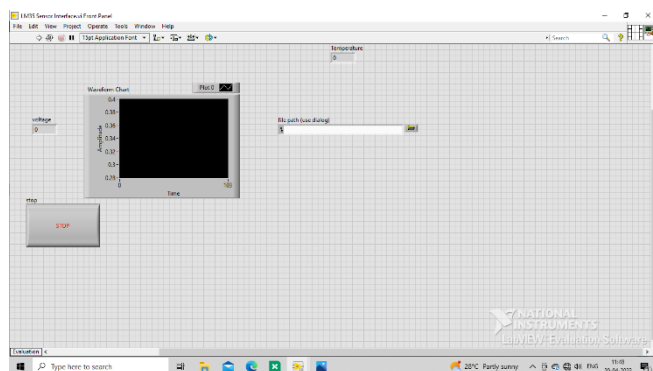


Fig 9: LM35 Front Panel

4.3 Interfacing of Thermocouple (K type)

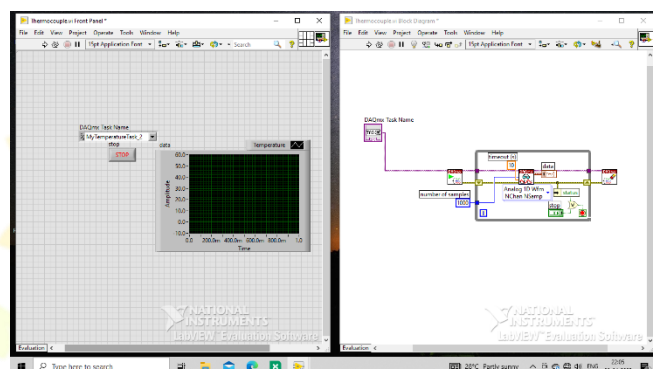


Fig 10: Thermocouple front panel and block diagram

In the above fig, the front panel and the block diagram of thermocouple is developed in LabVIEW software. The above structure is built to acquire temperature of hot water.

V. RESULTS

The results acquired from the sensors and PID controller are discussed below.

5.1 PID Temperature Controller Results:

The room temperature is measured by the PID through the RTD sensor mounted inside it. The values acquired by PID are displayed on the software.

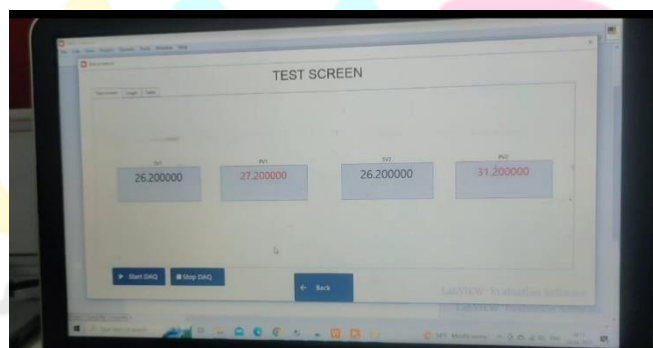


Fig 12: Test screen (PID)

The below figure shows the graphical representation of the values measured by the RTD of the PID controller. The graph is linear since the room temperature is constant with respect to time.

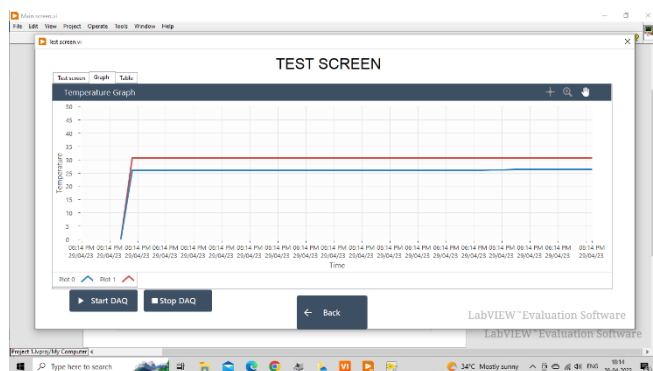


Fig 13: Temperature graph (PID)

The graph generated stores the data in the table which is shown below. This can be used in the future reference.

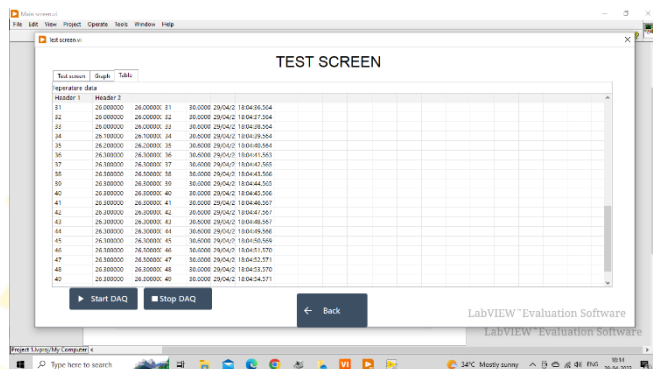


Fig 14: Temperature data sheet

5.2 LM35 sensor result

The LM35 sensor reads the value of voltage which is immersed in the boiling water. The voltage is converted to temperature using the formula mentioned above. Both graphical and numeric data is displayed on the front panel. Both voltage and temperature values generated gets stored in excel sheet with respect to time as shown below.

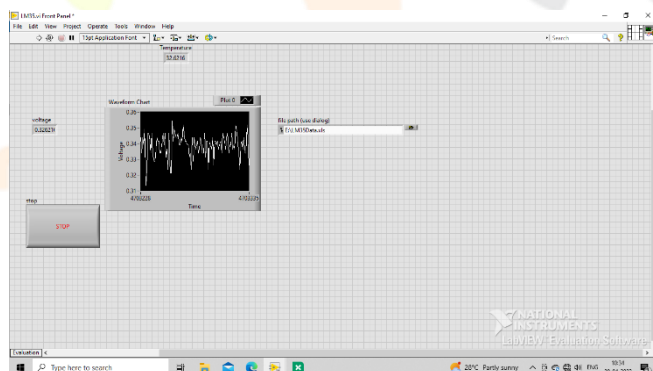


Fig 16: Front panel in run mode

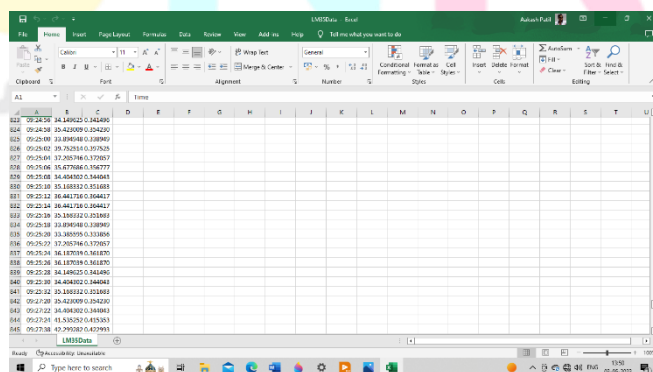


Fig 17: LM35 excel sheet

Through the LM35 experiment, we concluded that the voltage and temperature of the sensor is directly proportional. The readings are shown below:

TIME	VOLTAGE (mV)	TEMPERTAURE (oC)
04:24:25	0.8919	34.14
04:24:27	0.8998	37.96
04:24:29	0.8899	38.47
04:24:31	0.8898	38.98
04:24:33	0.8998	39.75
04:24:35	0.9099	40.77
04:24:37	0.9209	42.04
04:24:39	0.9889	43.57
04:24:41	0.9889	43.57
04:24:43	0.9810	45.10
04:24:45	0.9989	47.39
04:24:47	0.8198	51.56
04:24:49	0.8880	53.50
04:24:51	0.8890	55.70
04:24:53	0.88.91	58.91
04:24:55	0.8118	61.15
04:24:57	0.8889	65.39
04:24:59	0.8898	68.75
04:26:01	0.9081	70.81

Table 1: LM35 Readings

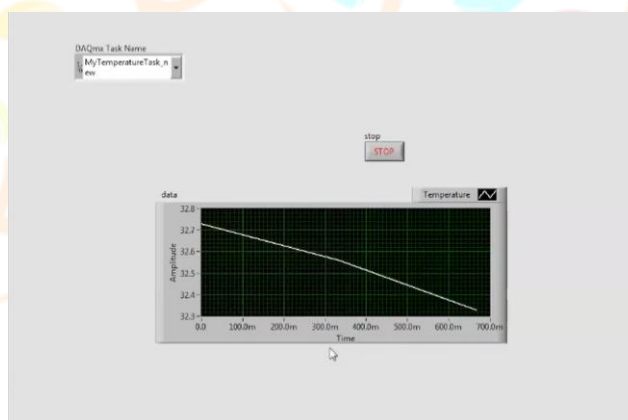


Fig 18: Temperature Graph

TIME	TEMPERATURE (oC)
14:13:33	27.2
14:13:36	27.8
14:13:39	28.5
14:13:42	30
14:13:45	32.6
14:13:48	33.4
14:13:51	35
14:13:54	37
14:13:57	45
14:14:01	47.3
14:14:04	48.8
14:14:07	50.2
14:14:10	34.5
14:14:13	32.8
14:14:16	30.6
14:14:19	29.7

Table 2: Thermocouple Readings

Through the thermocouple experiment, values were obtained in the increasing temperature range according to the change in water temperature.

VI. CONCLUSION

Hence, LabVIEW temperature data acquisition offers a reliable and effective way to collect and handle temperature data for a range of applications. The intuitive interface and sophisticated functionalities of the LabVIEW software make it the perfect tool for gathering and analyzing temperature data. We have successfully interfaced a PID controller with LabVIEW and obtained

temperature in our project. The voltage and temperature's proportionality property is demonstrated by the LM35 sensor result. PID interfaced with LabVIEW offers excellent precision and few errors.

REFERENCES

- [1] S. Padhee , Data logging and supervisory control of process using LabVIEW, Y. Singh,2011, doi: 10.1109/TECHSYM.
- [2] W. Zhan, Experiential Learning of Digital Communication Using LabVIEW, Feb. 2014, doi: 10.1109/TE.2013.2264059.
- [3] H. Flandorfer, F. Gehringer, E. Hayer, Individual solutions for control and data acquisition with the PC, Volume 382, Issues 1–2, 2002, Pages 77-87, ISSN 0040-6031, [https://doi.org/10.1016/S0040-6031\(01\)00739-0](https://doi.org/10.1016/S0040-6031(01)00739-0).
- [4] P. Kumar, Design and implementation of Smart Home control using LabVIEW. Chennai, India, 2017, pp. 10-12, doi: 10.1109/AEEICB.2017.7972317.
- [5] A. Gani and M. J. E. Salami, A LabVIEW based data acquisition system for vibration monitoring and analysis. 2002, pp. 62-65, doi: 10.1109/SCORED.2002.1033055.
- [6] N. Kashyap and U. C. Pati, Multi channel data acquisition and data logging system for meteorology application,S2015, pp. 220-225, doi: 10.1109/ICSTM.2015.7225418.
- [7] M. S. Murugan, L. Srikanth and V. P. S. Naidu,Design and development of LabVIEW based environmental test chamber controller.2017, pp. 1-4, doi: 10.1109/ICEECCOT.2017.8284638.
- [8] S. Ji, Y. Lei and W. Zhang, The design of data acquisition system based on virtual instrument. 2012, pp. 594-597, doi: 10.1109/ICCSNT.2012.6526007.
- [9] N. Khera, H. Gill, G. Dodwani, N. Celly and S. Singh, Remote Condition Monitoring of Real-Time Light Intensity and Temperature Data, 2015, pp. 3-6, doi: 10.1109/ICACCE.2015.111.
- [10] V. R. Mutha, N. Kumar and P. Pareek, Real time standalone data acquisition system for environmental data, 2016, pp. 1-4, doi: 10.1109/ICPEICES.2016.7853337.
- [11] A. K. Gupta, N. S. Chauhan and R. Saxena, Real time I-V and P-V curve tracer using LabVIEW, 2016, pp. 265-269, doi: 10.1109/ICICCS.2016.7542320.
- [12] M. Serbanescu, V. M. Placinta, O. E. Hutanu and C. Ravariu. Smart, low power, wearable multi-sensor data acquisition system for environmental monitoring. 2017, pp. 118-123, doi: 10.1109/ATEE.2017.7905059.

