Data Acquisition and control of Level for critical processes using LabVIEW

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ABSTRACT

LabVIEW is the most widely used graphical programming environments for designing Process control systems. Unlike conventional text-based programming languages such as C, C++ and MATLAB, graphical programming involves block-based code developments, allowing a more efficient mechanism to build and analyze control systems. In this paper a LabVIEW environment has been employed as a graphical user interface for monitoring & controlling the level and Flow operation, by visualizing both the closed loop performance and the user selected control conditions, while the real time standalone system was established using cFP 2020, AIO 610 modules with 100BaseTX Ethernet. This tool has been applied to the ON/OFF controller for a binary tank column. By means of such integrated environments the control designer is able to monitor and control the plant behavior and optimize the response. We achieved a transfer rate of 100 Mb/s and able to control the system with online and offline capabilities.

***Keywords*— S**oftware tools, LabVIEW, cFP-2020Compact field Point), AIO-610(Analog Input output).

I. INTRODUCTION

LabVIEW [1] is the widely used graphical code development environment which allow system-level developers to perform rapid prototyping and testing. Such graphical based programming environments involve block-based code development and offer a more intuitive approach to modelling and control task in a great variety of engineering disciplines, such as process engineering. The establishing of a standalone system using cFP, AIO modules is easy using the Real time toolkits. By desigining the graphical code using LabVIEW and deploying

them into the cFP Real time hardware for control prototyping and hardware-in-loop testing, with proven results in industrial application [2]. Level and Flow monitoring constitute a major part of most chemical engineering plants and remains as the most important process variable in chemical process industries around the world [4]. Therefore, improved Level and Floe control can have a significant impact on reducing energy consumption, improving product quality and protecting environmental resources. However, both level monitoring and control are difficult task because the plant behaviour is usually nonlinear, non stationary, interactive, and is subject to constraints and disturbances. Besides the application of such techniques to real experimental plants are limited by the high cost of the equipment. The aim of this paper is to establish a remote station for monitoring the level and Flow which are the vital parameters of any process. The LabVIEW environment used for its monitoring and control. This combined scheme has been employed to the control of a binary tank column. The LabVIEW graphical user interface designed enables the visualizing of both, the closed loop performance and the user selected control conditions, where the front panel has been designed mimicking the tank column control scheme.

In section II we describe the overall structure of tank and level control system while the real time model is done using cFp modules summarized in section III. The design of the monitoring system under LabVIEW is described in section IV, and computer simulation results for a Tank level and flow are also shown in section V. Finally, conclusions and results are also discussed in section VI.

II BLOCK DIAGRAM FOR LEVEL PROCESS

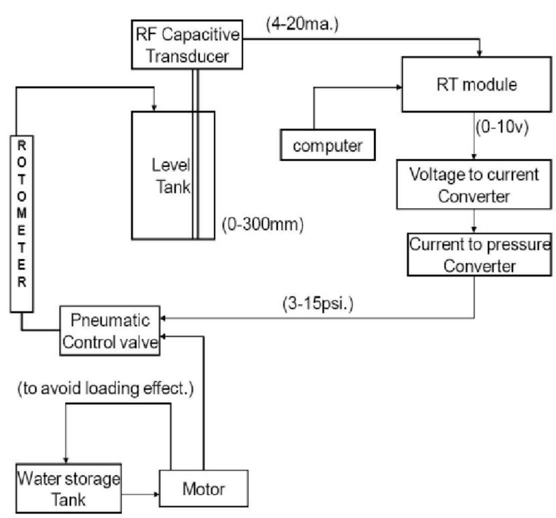


Figure 1 Block Diagram of the Level and Flow process.

The water from the storage tank is pumped by the motor to the level tank using the pneumatic control valve. The inflow rate is determined using the Rotameter [4]. The change in the tank level is measured in terms of current using an RF capacitive Transducer. The data logging is done using an RT module (cFP-2020, AIO-610). The monitoring and control is done using LabVIEW Real-Time software.

III OVERVIEW OF CFP

Compact Field Point is a programmable automation controller (PAC) designed for industrial control applications performing advanced embedded control, data logging, and network connectivity. It combines the packaging, specifications, and reliability of a PLC with the software, flexibility, connectivity, and functionality of a PC.

Compact Field Point is a reliable platform designed for rugged industrial environments with shock, vibration, and temperature extremes. cFP-21xx controllers run LabVIEW Real-Time,providing the functionality, connectivity, and flexibility of NI LabVIEW software on a small industrial platform. The modular I/O architecture with built-in signal conditioning and isolation provides direct connectivity to industrial sensors such as analog voltage, 4 to 20 mA current, thermocouples, RTDs, pressure, strain, flow, pulse-width modulation (PWM), and 24 V digital I/O. You can use NI cFP-21xx controllers in intelligent distributed applications requiring industrial-grade reliability –such as process and discrete control systems – to open and close valves, run control loops, log data on a centralized or local level, perform real-time simulation and analysis, and communicate over serial and Ethernet networks.

IV DESCRIPTION OF THE REAL TIME FRONT PANEL AND BLOCK DIAGRAM

The desired level of liquids can be attained remotely by Ethernet based process control. The software used for this is LabVIEW. The virtual program developed using LabVIEW, which controls the level of liquid in the tank, based upon the inflow rate, high level and low level limits. In our program we used on-off control. The sub VIs used are Average, Boolean algebra, Level tank. The virtual program can be deployed to cFP-2020(compact field point) module. The AIO module 610 is helpful in acquiring the inputs, in the form of current/voltage. But it gives only voltage outputs.

In our program we took the set point for the level as 160mm and due to the offset the upper limit and lower limit are 150mm and 170mm respectively.

Figure 3 Block Diagram for the Level Process control

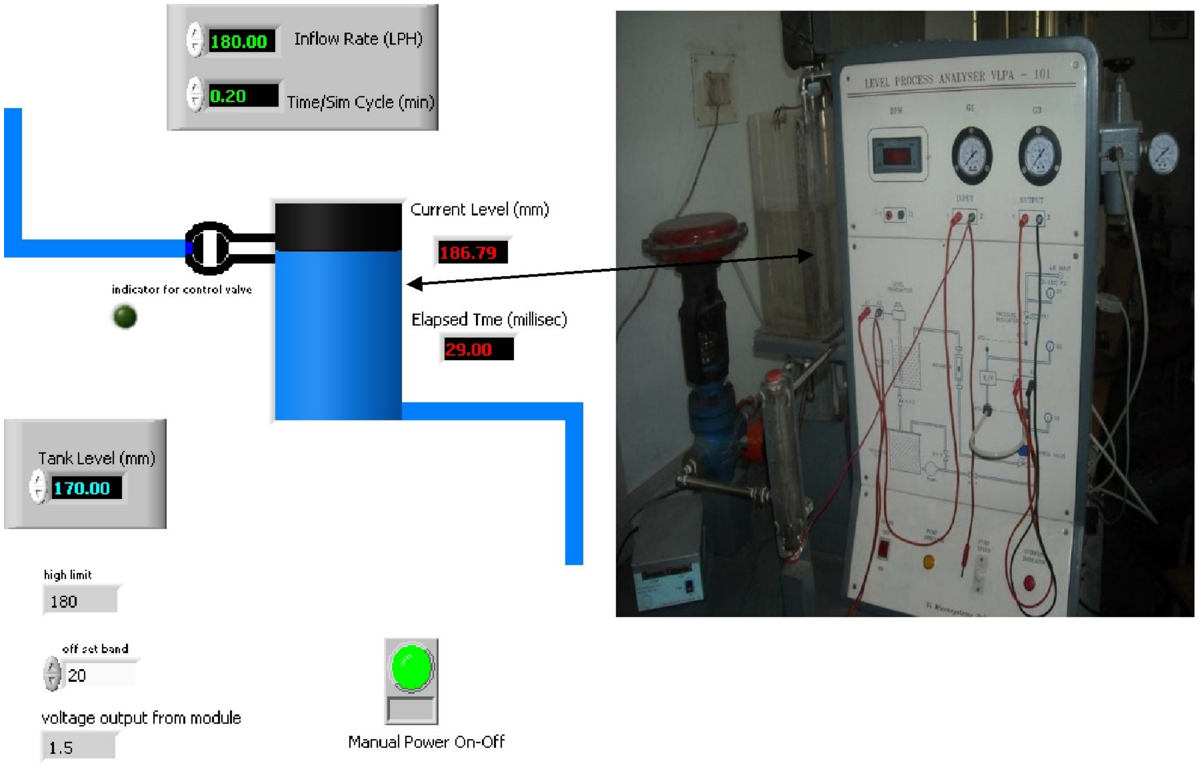
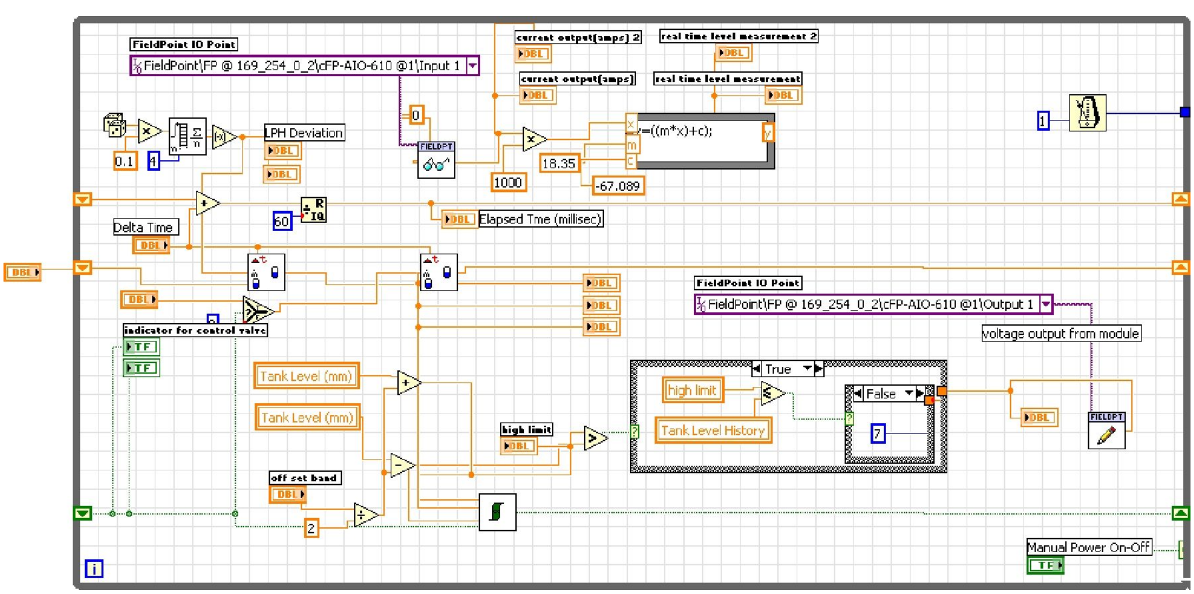


Figure 2. Front Panel

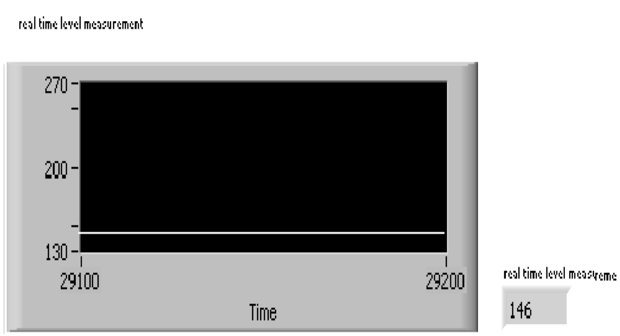


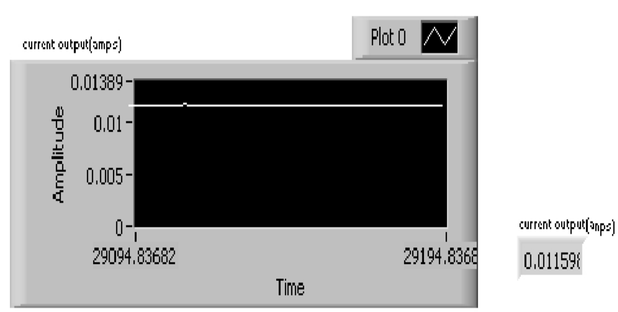
150mm the reverse acting pneumatic valve is opened to fill the tank until it reaches the upper limit. At 170mm, the reverse acting pneumatic valve is closed
to limit the level of the tank. The calibration is made such that the output of AIO module at lower limit is 7v and upper limit is 1.5v.Since we need to give the current signal (4-20mA) to the I-P converter we are using a V-I converter (0-10V, 4-20mA).The Calibrated values are-14.7mA - 7v, 4mA - 1.5v.The current output from V-I converter is applied as input to I-P converter (ABB TEIP-11). When the input is in the range of 14.7-4mA it pumps 11-3 Psi of pressure to the reverse acting pneumatic control valve such that it opens 50% of its full value at 11Psi and 0% at 3 Psi.

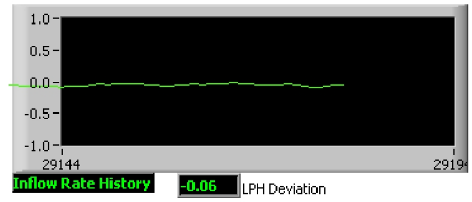
The RF capacitive transducer generates current output depending upon the level which is acquired by AIO-610, and is calibrated using formula node thus displaying on the front panel in terms of level. For 10mm and 300mm the current outputs from RF capacitive transducer are 4.2mA and 20mA respectively. The calibration formula used is Y=18.35X-67.089,X-abscissa represent the current ,and the Y-ordinate represent the level.

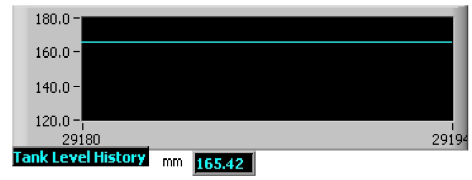
V RESULTS

. The results are shown below









VI CONCLUSION

We conducted this research work in the department
of Electronics and Instrumentation, Process Control Laboratory at VNRVJIET and it accomplished to be suitable for the expected task of the executing. our aim was to control the level process from a remote area, in which we simulated the level process using LabVIEW.

VII FUTURE ENCHANCEMENT

We implemented this simulated process in real time using NI Compact Field Point 2020 and Analog Input Output module AIO610 .A standalone system can be designed using the above hardware and software. Furthermore a detailed data log can be prepared and submitted regarding uncertainties which can be even authenticated.

VIII ACKNOWLEDGEMENT

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VII REFERENCES

[1] G. O. Bishop, R. *Learning with LabVIEW 7* Express, New Jersey, Prentice Hall, 2004.

[2] N. A. Muhamad, S. Ali, “LabVIEW with fuzzy logic controller simulation panel for condition.