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Real Time Implementation of Two State Level Control in Conical Tank using labVIEW

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ABSTRACT: Level control plays a vital role in many process industries. But manually maintaining the level of a large tank at a particular set point is very difficult. To overcome this, systems can be used to monitor and control the level automatically. By using a suitable hardware and software programming this can be achieved. Here the level of a conical tank setup is monitored and controlled using a suitable software coding and appropriate hardware. The corresponding current and voltage for each centimetre of level in the conical tank is measured. A program is developed to control the control valve in the conical tank setup to maintain the level in LABVIEW using myRIO. The program is developed on the basis of current and voltage readings taken from the conical tank. If the set point is reached, the LABVIEW programming automatically controls the control valve through NI myRIO which is connected to the system. By connecting myRIO with the computer, the program directly deployed in the myRIO device and so that it can acquire real time values and make the corrective control actions.

KEYWORDS: Conical level control, NI LabVIEW, NI myRIO.

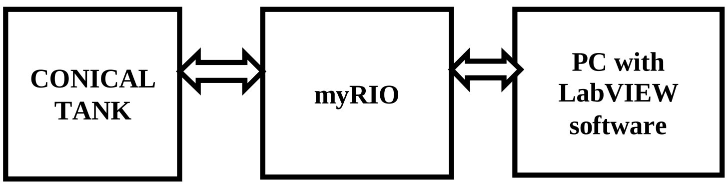
I. INTRODUCTION

The conical tank setup is connected with the control valve kit. Through this we can get the inflow for the tank. The flow is regulated and maintained constant at 50 LPH throughout the process using the rotameter present in the kit. The conical tank we used here is a circulating tank hence the outflow is regulated by a valve and then circulated back to the tank in the control valve kit. A differential pressure transmitter (DPT) is connected to the conical tank. The terminals of the DPT are connected to the circuit diagram which is constructed to measure the voltage and current readings for corresponding level measurements.

Now the myRIO is connected with the system. The real time values (i.e.) current and voltage from the conical tank level process is acquired by myRIO. A program is developed with the logic that if the voltage for required set point (level) is reached, the control valve will close. This can be achieved by connecting the controller output with the circuit. The program for this process is deployed in myRIO. So from the acquired real time voltage and current, the control action is performed and generated to the control valve by NI-myRIO. In the front panel of the LABVIEW program, we can see the voltage for its corresponding level in the conical tank and after reaching the setpoint the program will stop and closes the control valve.

II.BLOCK DIAGRAM

In the below block diagram, it is shown that conical tank process parameters are controlled using NI-LabVIEW which are interfaced through myRIO.



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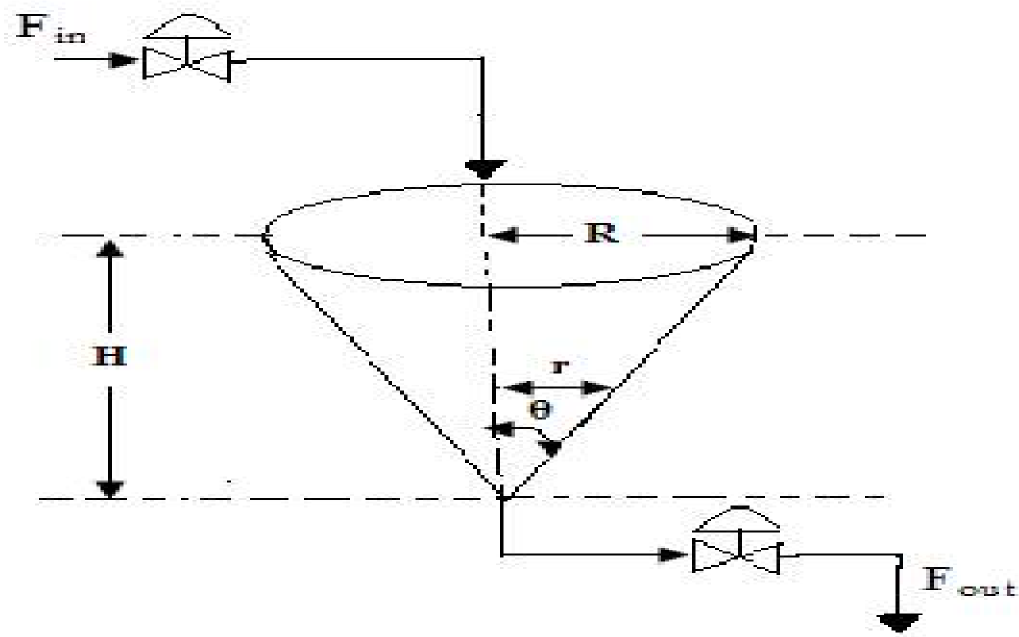
III.SPECIFICATIONS OF THE EXPERIMENTAL SETUP

A.CONICAL TANK:

The conical tank used in the process is having the following specifications[3].

Material	:	stainless steel
Height	:	40cm
Volume	:	11.39litres
Bottom diameter	:	10cm
Top diameter	:	25cm
Angle	:	10deg



B.INTRODUCTION TO LABVIEW:

LabVIEW is Laboratory Virtual Instrumentation Engineering Work bench. It is a platform that lets you to interface a computer with an experiment. It is a Graphical Programming Language that use the icons instead of lines of text to create applications in text based programming. It uses the data flow programming concept. It is extremely powerful, allowing you to generate and measure analog and digital voltages as well as control the timings of such operations. In order to be such a powerful application, there is a huge amount of flexibility in what you can program[1]. The LabVIEW programming environment utilizes two windows. The first is called the Front panel and it is the place where we enter and obtain information and output from the program or simply we can say controls and indicators are present.

The second window is called the Block diagram in which we can write the program coding by wiring graphical objects together. In LabVIEW, a program is called a VI (virtual instrument). When a VI is saved, both the Front panel and the Block diagram are saved. If we open a VI, the Front panel alone is opened. To see the Block diagram, we can select it from the menu or we have to click ctrl+T. while programming, it is useful to have both the Front panel and Block diagram open on the same window. The tool palettes and the menu selections are different for the two windows.

When we right click on the front panel, we will get the controls palette. This palette supplies the indicators, controls, graphical displays like waveform graph, chart, X-Y graph, etc. If we want a control or indicator, just we have to drag that icon to the Front panel window. When a control or indicator is dragged on to the Front panel, an object corresponding to it will automatically appear on the Block diagram.

When we right click on the block diagram, we will get the functions palette. From there we can drag the objects required for our program coding and place it in the Block diagram window.Once all the required objects are placed in

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both the windows, we can wire them according to our coding so that all the proper operations are performed. Wiring is done by clicking and dragging the wiring tool from terminal to terminal .Once the wiring is done, the VI is saved in the usual way with .vi as the extension[2]. After this we will run our program. Based on our coding, we will get the appropriate output on the Front panel.
One complication is that there are many data types in LabVIEW and each object requires and produces certain input/output. LabVIEW uses labels and colors to make this easier, but it is apart of the programming that needs careful attention. The data types in LabVIEW are 16 bit signed integers (I16), single and double precision real floating point numbers (SGL and DBL), Boolean states (i.e.) true or false, string type data, etc. The Vis operation imitates physical instruments like multimeter, oscilloscope, etc. Every VI uses functions that manipulate input from the user or from other sources and display the information or output in the front panel window or move it to other files or to other computers.

APPLICATIONS OF LabVIEW:

- Bio-medical electronic station
- Distributed data acquisition
- Instrument control station
- Computer based data acquisition stations
- Military and security services
- Robotics laboratory
- Space research and Rocket launching stations.

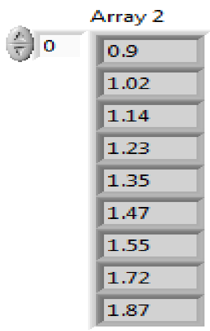
C.INTRODUCTION TO myRIO:

NI myRIO is an embedded hardware device that introduces industry proven technology and allows us to design real, complex engineering systems more quickly and affordably than ever before[4]. myRIO have dual-core ARM® Cortex™-A9 real-time processing and it uses the latest Zynq technology from Xilinx featuring an FPGA integrated with a processor running a real-time OS. With its onboard devices, seamless software experience, and library of courseware and tutorials, myRIO provides an affordable tool that we can use to do real engineering.This powerful technology coupled with an onboard accelerometer, programmable LEDs, audio I/O, analog and digital I/O, and USB port helps thousands of ideas come to life[5].It is a device for controls, robotics, mechatronics, and embedded concepts.

IV.WORKING SETUP

First the control valve for the conical tank setup is selected. Here from the control valve kit, the linear percentage valve is selected. The flow of water from the overhead tank of the control valve kit is maintained at the rate of 50LPH. That is given to the conical tank as the inflow. The regulator at the outflow of the conical tank is at partially closed condition. A Differential Pressure Transmitter is connected with the conical tank. The connection part in the hardware side is completed. The terminals from the DPT, a Regulated power supply, a multimeter and a Decade Resistance Box (DRB) is placed on a Breadboard as per the circuit diagram.

FRONT PANEL: (Fig 1)



The above front panel indicates the corresponding for each and every cm of level. For ‘0 cm’ of level, the corresponding voltage from transmitter is 0.9 V and for ‘1 cm’ of level, the corresponding voltage from the transmitter is 1.02 V. similarly for every cm of level, the corresponding voltage is displayed.

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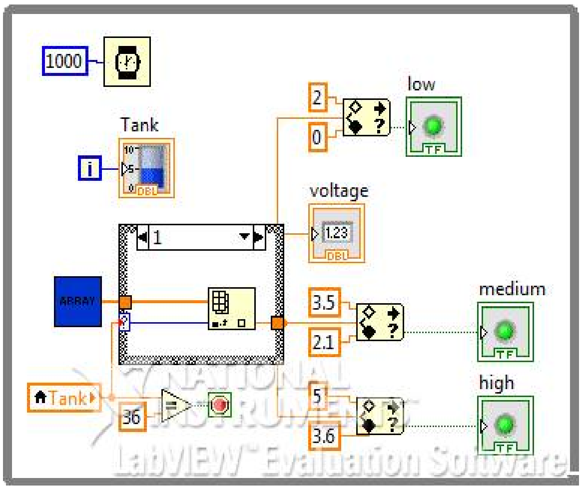
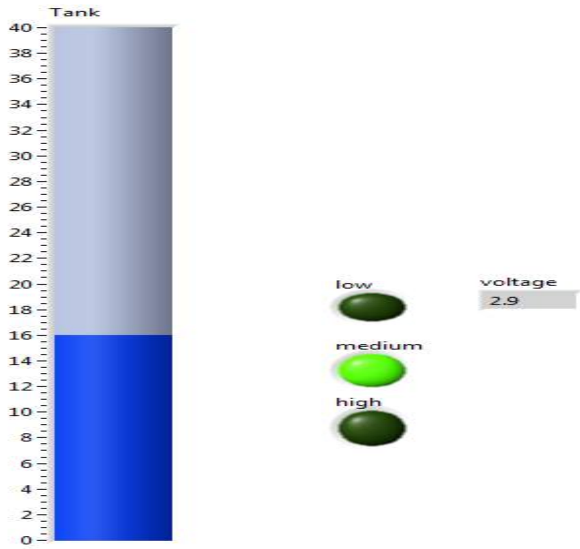
BLOCK DIAGRAM: (Fig 2)



This VI get the values of level as input from its Sub VI and it indicates the level by glowing the corresponding LEDs. This is the simulation VI in which we specifies the particular range as low, medium and high.

FRONT PANEL: (Fig 3)



myRIO is also connected to the circuit which is parallel to the multimeter to acquire voltage. In the computer, program is developed using myRIO Icon and setpoint is specified in the program. When the setup is turned On and the LabVIEW program is made to run, the water from the control valve kit flows into the conical tank and for each centimeter increase in level in the conical tank the voltage will vary from 0-5V and the current will be in the range of 4-20mA. This current and voltage values are acquired also by the myRIO simultaneously. That we can see in the front panel of the programming window. If the setpoint is reached, the computer will controls the control valve and closes it to stop the inflow in to the tank through myRIO and then the program stops.The control valve that we used is normally open and so to close it fully we should give 15 psi as its input which is equal to 20mA.

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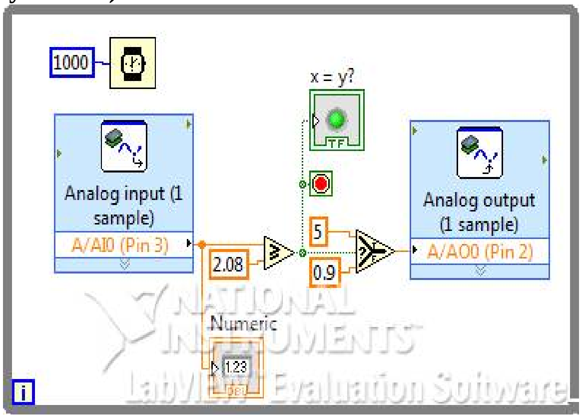
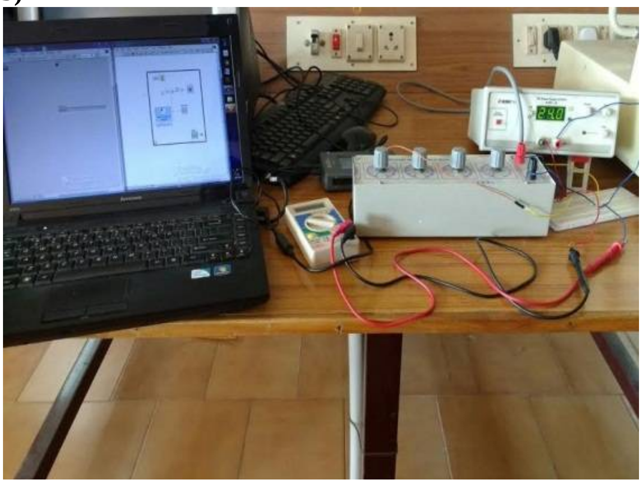
BLOCK DIAGRAM: (Fig 4 –myRIO VI)



This VI stops when the process reaches the set point.The analog input acquires voltage from level transmitter and the analog output will give either 0.9v or 5v as output.This output has converted into current with V-I converter i.e 4 mA or 20 mA.This will given as input to I-P converter which converts it into 3 to 15 psi.Since the control valve is normally open , 5v -> 20 mA -> 15 psi will close the control valve fully.Hence the set point is maintained.

REAL -TIME SETUP: (Fig 5)



This Real time setup (Fig-5) with myRIO is used to acquire input (Process variable) and to generate output (Controller output).Hence we can control the level process using NI-LabVIEW and NI-myRIO.

V. RESULT AND CONCLUSION

Automatic ON –OFF level control is the main aim of this experiment. Through this we can achieve that goal by controlling the control valve of a conical tank using myRIO and LabVIEW programming. So without manual intervention the system can stops the flow if the desired setpoint is reached. Here myRIO is used which is very useful in acquiring and controlling the system. we can create wireless connection using myRIO. Hence we can connect the myRIO to a mobile phone through Wifi and we can monitor the system using our mobile if we have Dashboard application.

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