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Research Paper

Flow based valve position control using NI my DAQ

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Abstract

This paper emphasizes the required valve position by servo mechanism, which decides the flow rate through pipe. The servo position is decided through Ni Lab View virtual indicator& the same position is tracked by potentiometer with NI My DAQ. The deviation of the valve position is finding by comparing both the positions. This study will helps to maintain the desired flow value where flow rate plays an important role such as Pharmaceutical industry, bottle filling industry Etc.

Keywords: *NI My DAQ; NI Lab VIEW; Potentiometer; Servo Mechanism.*

1. Introduction

Nowadays, flow controlling mechanism is used in industry for the automation process. Flow and its rate is vital parameter in chemical, food and process industries in estimation of correct composition and confirmation of accurate volume to be mixed. The conventional way of flow control is through an electromechanical solenoid valve switch in which, the valve opening and closing is inside a concealed chamber [1], [2]. The accuracy of valve opening cannot be observed externally hence one must compromise with the performance limitations [3]. In an order to have a precise Control over the flow feedback valve position is needed, so this paper proposed an automatic valve controlled mechanism to control flow by using NI Lab VIEW [4].

2. Experimental setup

A schematic diagram of experimental setup is shown in Fig. No. 1. The setup consists of water
Reservoir, water pump (0.5H.P), servo motor (Voltage: 3-6 V, Shaft Diameter: 5mm - Length: 22mm, Torque: 4.2 Kg-cm, Step Angle: 1.8^0 / step, Motor Size: 42x42x40 mm), potentiometer (10 KΩ), NI My DAQ [4], high end configured PC. A channel is created with a mechanical ball valve and flow is collected in a known volume rectangular container.
NI My DAQ is a sophisticated tool from National Instruments to interact with the real time signals with a programmable controllability over the sensor data.

3. Process description

The electrical motor pumps the water from reservoir to the collecting tank through a servo motor controlled valve (mechanical). Depending on the required flow rate, the servo motor will turn the mechanical valve. The servo motor operates with a output signal from NI My DAQ.

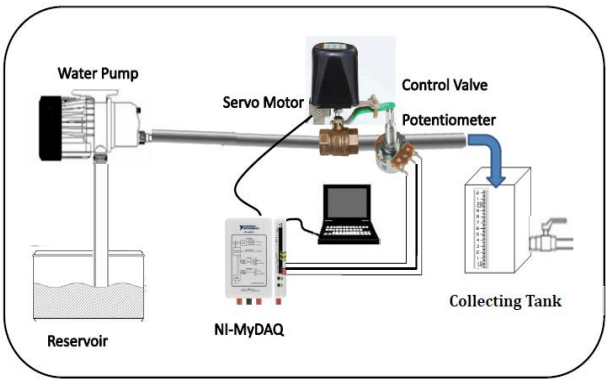


Fig. 1: Process Flow Diagram.

The potentiometer, which is attached to the valve, also rotates along with the valve. The output of the potentiometer is fed to NI My DAQ, to estimate the position and to find the error in position otherwise the error in position leads to flow inaccuracies[2]. The entire process is simulated in the NI LabVIEW simulation tool shown in Fig No. 3(a).

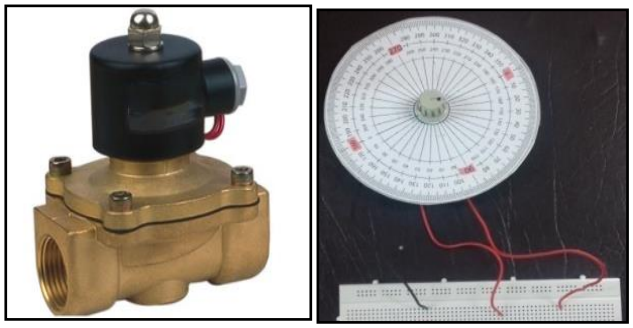


Fig. 2: Solenoid and Potentiometer Transducers.

The selected valve position sensor potentiometer has 3 terminal has a slightly deviated position with output voltage response shown in the Fig No. 2.

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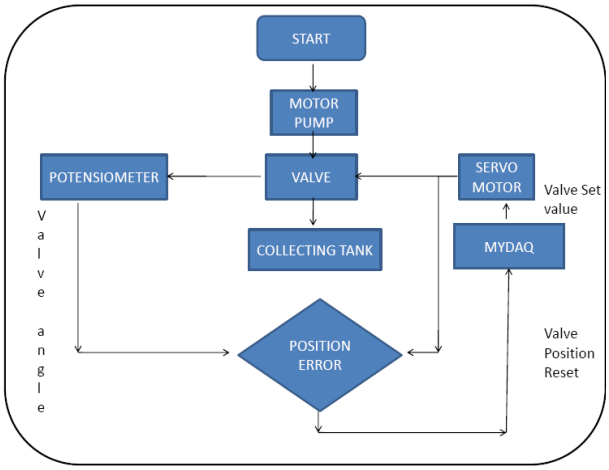


Fig. 3: (A) Process Flow Diagram in Lab view.

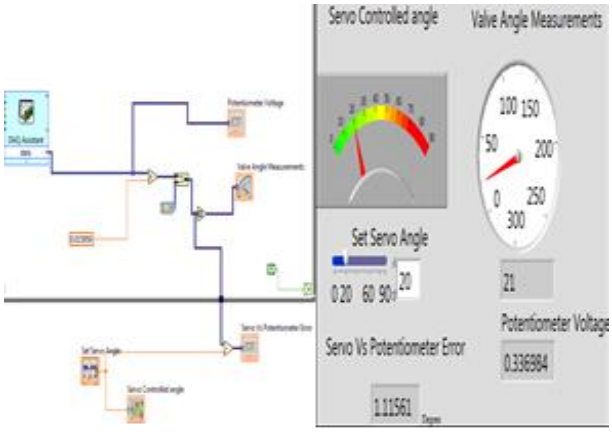


Fig. 4: Ni Lab View Schematic Diagram.

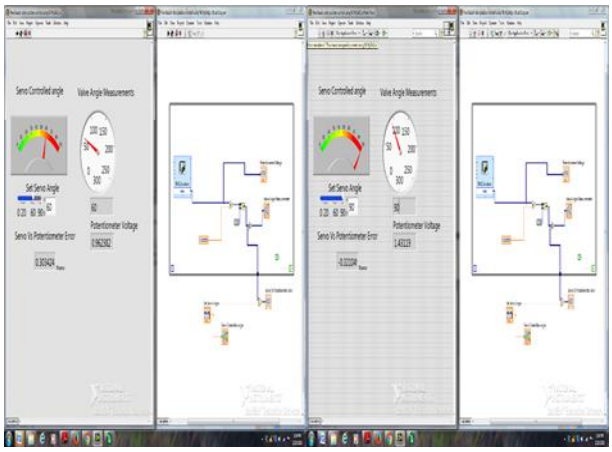


Fig. 5: Simulated Results for 0 and 30 Degrees Valve Position in Lab VIEW.

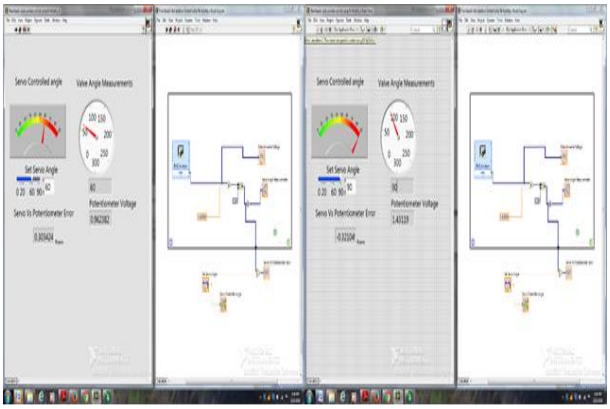


Fig. 6: Simulated Results for 60 and 90 Degrees Valve Position in Lab VIEW.

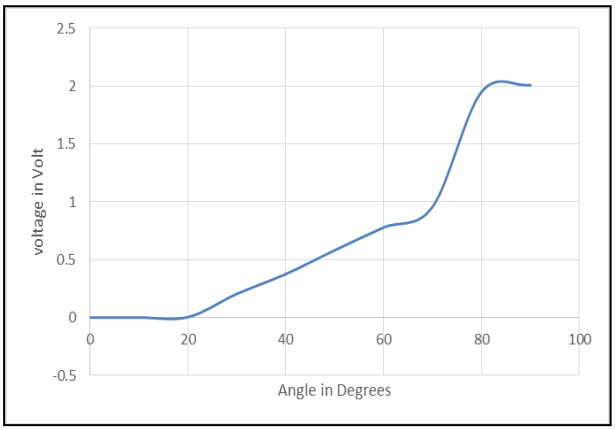


Fig. 7: Potentiometer Characteristics.

4. Implementation and results

The proposed setup is executed as per the process flow diagram, initially Servo motor is turned on using a set valve through the MyDAQ AO(analog output) '0' pin [4], there are 5 pre-selected valve 0,20, 30,60 and 90. In the range of 0-90^{o} valve position. If the valve position is 0 indicates valve fully opened with maximum possible flow rate through the channel and if 90 degrees then the valve is closed. The Potentiometer output pin is connected to MyDAQ AI (analog input) '0' pin[4]. The Servo position set value and the potentiometer feedback value is compared to get the error in the position.

The measured error in the valve position is obtained as 1.11 degree when the servo set angle is 20 degrees and the percentage of accuracy in valve position is 94.45, The Screenshot of the Front panel and the block diagram of virtual instrumentation panel is displayed for the reference as shown in the Fig No:4.

The Fig No: Five & 6 shows the screenshots of the virtual Instrumentation modeling in the Lab VIEW for the Servo valve positions as 0, 30 and 60, 90 degrees also displayed the position errors. The Error plot from the Fig No: 8 is non uniform due to the step angle resolution as per the datasheet 1.8^{0} / step.

5. Conclusion and the future scope

The results are tabulated and the obtained range of accuracy as 94.1 to 99.64 % in turning the valve from 0 to 90^{0} shown in Table No: 1, Fig No: 8. the deviation of valve from the error analysis is a key input for the error correction. The present work can be extended with a P/PID controlled feedbackto maintain accurate flow rate in a channel [1], [2].

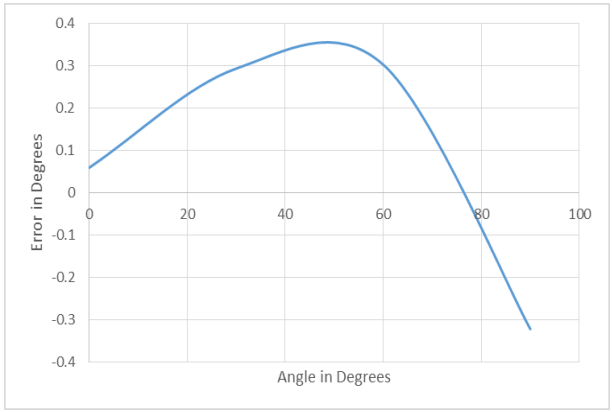


Fig. 8: Valve Position VS Error in Valve Position.

Table 1: Valve Position Accuracy Analysis

Servo Set Value (Degree)	Potensiometer valve angle(Degree)	Deviation in the valve position(Degree)	%Error	% Accuracy
0(Offset)	0.060084	0.060	0	100
20	18.889	1.111	5.881	94.11
30	29.705	0.294	0.990	99.00
60	59.696	0.303	0.508	99.49
90	90.321	-0.32	0.355	99.64

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