Speed control of DC motor using LabVIEW

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***Abstract*-The projects aim is to control the speed of dc motor by using the PID controller in Lab VIEW. It combines the advantage of proportional, derivate and integral control action. DC motors are used extensively in industrial variable speed applications because of most demanding speed torque characteristics and are simple in controlling aspects. The motor speed is kept constant in this experiment. The simulation result of the experiment shows that a motor is running approximately at a constant speed regardless of a motor loop. It is concluded that a PID controller is a successful tool for controlling the motor speed in presence of load disturbances. The rpm of the dc motor is sensed and given as an input to the DAQ by the proximity sensor.**

***Keywords*: DC motor, Speed, PID, Setpoint, Sensor, Closed loop, LabVIEW**

I. INTRODUCTION

DC motor converts electrical energy into mechanical energy. All dc motors have internal mechanisms such as electro mechanical or electronic to change the current flow direction. Large dc motors have various applications such as propulsion of electric vehicles, elevators, etc. the origin of the ac motor is possible by the advent of power electronics. Speed of the dc motor can be controlled by flux control method, armature control method, voltage control method. In open loop system the output is not reliable and accurate. So to get accurate results closed loop systems are used. Closed loop system automatically regulates a process variable to a desired state or set point without human interaction. In this project, the speed of the dc motor is measured by the proximity sensor and it is given to the PID controller. The PID controller varies the output according to the set point in PID. The overall closed loop plant is described in Fig.1.Block diagram of dc motor speed control.

II. BLOCK DIAGRAM

The closed loop system consists of DC motor, proximity sensor and PID controller controlled by LabVIEW. The dc motor is controlled by a user interface LabVIEW through PID controller which processes the output of the sensor and controls the output. i.e.: motor. The LabVIEW controls the speed of motor where the output is monitored and compared with proximity sensor through a PID controller to give a desired speed of the motor.

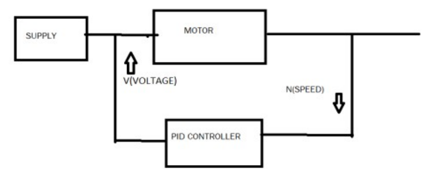

Fig. 1.Block Diagram of dc motor speed control

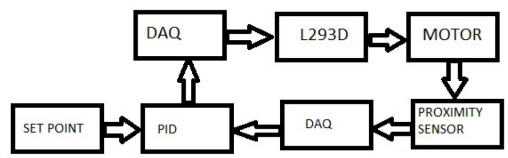

Fig .2.Overall block diagram of LabVIEW based speed control

The overall block diagram[1] of LabVIEW based speed control is shown in Fig.2. The motor is drive by using a driver IC(L293d).The output from the motor is given to the proximity sensor. The proximity sensor senses the output voltage and it is given to DAQ. From the DAQ it is given to the PID controller. The PID Controller generates the difference or error[2]. The error is reduced by varying gain of PID.

III. PROJECT EXPLANATION

Lab VIEW(Laboratory virtual instrument engineering workbench)is a system design platform and devolvement environment for visual programming language from national instrument. In lab view there are two main components front panel and block diagram. Front panel is just a user interface .block diagram shows the internal connection of design .

3.1.L293d

L293d is driver IC which is used to drive the dc motor. The pin diagram of L293D is shown in Fig.3.It is 16 pin IC. Pin 1 and pin 8 are shorted and it is given to supply .The supply is regulated power supply of 5v.Pin2 is input pin which is given from the DAQ.Pin3 is output pin which is given to the one terminal of the motor. The another terminal of the motor is given the ground Pin4.

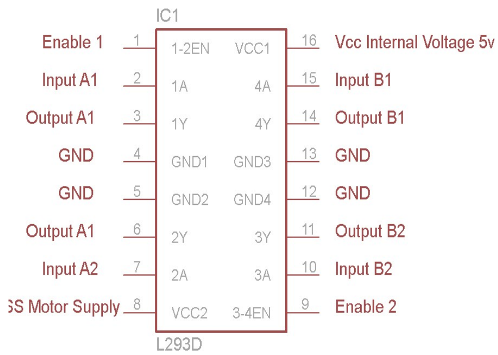

Fig .3. Pin Diagram of L293D

3.2. PID Controller:

A proportional–integral–derivative controller[3] (PID controller) is a generic control loop feedback mechanism (controller) widely used in industrial control systems– a PID is the most commonly used feedback controller. A PID controller calculates an "error" value as the difference between a measured process variable and a desired set point. The controller attempts to minimize the error by adjusting the process control inputs. A PID controller consists of a Proportional element, an Integral element and a Derivative element, all three connected in parallel. All of them take the error as input. Kp, Ki, Kd are the gains of P, I and D elements respectively. The PID controller compares the measured process value with a reference setpoint value. The difference or error, e, is then processed to calculate a new process input. This input will try to adjust the measured process value back to the desired setpoint. The alternative to a closed loop control scheme such as the PID controller is an open loop controller. Open loop control (no feedback) is in many cases not satisfactory, and is often impossible due to the system properties. By adding feedback from the system output, performance can be improved.

The error will be managed in three ways, to:

1. Handle the present, through the proportional term
2. Recover from the past, using the integral term
3. Anticipate the future, through the derivation term

The transfer function of the PID controller looks like the following:

$$K_p + \frac{K_I}{s} + K_D s = \frac{K_D s^2 + K_p s + K_I}{s}$$

Kp = Proportional gain

Ki = Integral gain

Kd = Derivative gain

3.2.1. The Characteristics of P, I, and D Controllers

A proportional controller (Kp) will have the effect of reducing the rise time and will reduce but never eliminate the steady-state error. An integral control (Ki) will have the effect of eliminating the steady-state error, but it may make the transient response worse. A derivative control (Kd) will have the effect of increasing the stability of the system, reducing the overshoot, and improving the transient response. Effects of each of controllers Kp, Kd, and Ki on a closed-loop[4] system are summarized in the Table.1.Characterstics table[5] of PID gain as shown below.

CL response	Rise time	Overshoot	Settling time	s-s error
K_p	Decrease	Increase	Small change	Decrease
K_i	Decrease	Increase	Increase	Eliminate
K_d	Small change	Decrease	Decrease	Small change

Table 1.1.Characterstics table of PID gains

3.3. DAQ (Data Acquisition):

DAQ is the process of measuring an electrical parameters such as voltage, current, temperature, pressure etc. DAQ have 68 pin. Input pin AI0 to AI 15. Output pin AO 0, AO1.In this project we use 22,23,32,55 pin. The pin diagram of DAQ is shown in Fig.4.

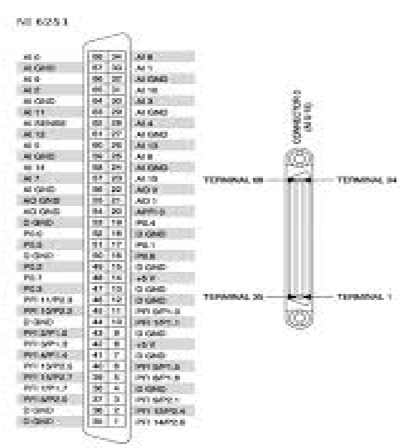

Fig.4.Pin Diagram of DAQ

3.4. Proximity Sensor:

A proximity sensor[6] is a sensor able to detect the presence of nearby objects without any physical contact. A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal. In this project proximity sensor sense the how many times the metal object cross the sensor for the period of one minute. The proximity sensor give the output to the DAQ which in turn manipulated by the PID controller. Here NPN proximity sensor of 4mm measurable range of input voltage of 4V to 40V has been used.

IV. EXPERIMENTAL SETUP:

By varying the slide, the set point is set to desired value. The process variable is compared to the set point to produce the difference by PID. The PID adjusts the output according to the set point in terms of gain. The proximity sensor output can be checked using gauge. And, the overall manipulated output is given to DAQ, then to the driver circuit L293d which drives the output. The experimental setup of hardware is shown ion Fig.5

Fig 5.Experimental setup of hardware of desired setpoint of 10

V. RESULT

The output from the proximity sensor is given to the DAQ assistant 1. It is given to the PID process input. The point compares the setpoint and process variable and give the output. On experimenting, PID which processes the output goes on increasing step by step speed to desired setpoint. With our desired setpoint of 10, the compared output of PID increases on a decimal value shown in the following figures. In Fig.6.1.Output of 7.85V

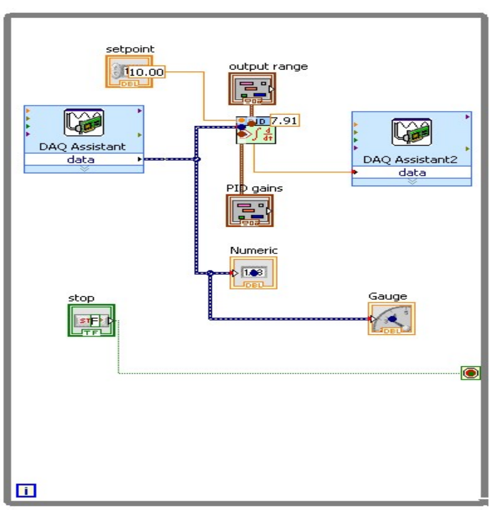

Fig.6.1.Output is 7.85V

The output from the proximity sensor on increasing to desired setpoint and output is 7.91V as shown in Fig.6.2. and output of 8.31V as shown in Fig.6.3.

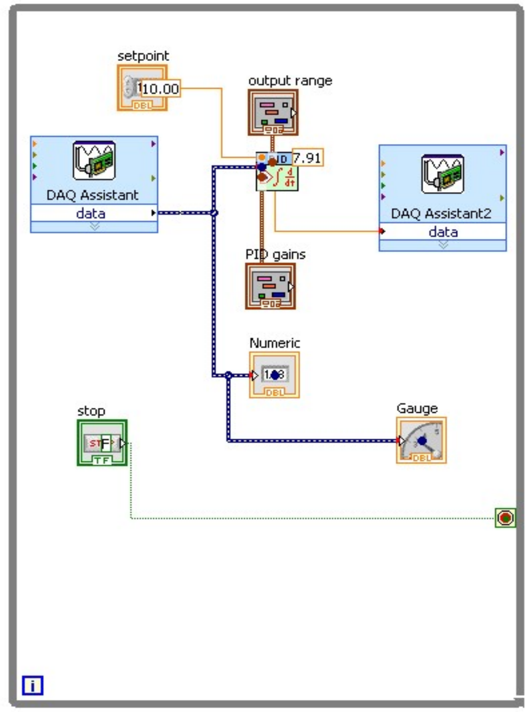

Fig.6.2.Output of 7.91V

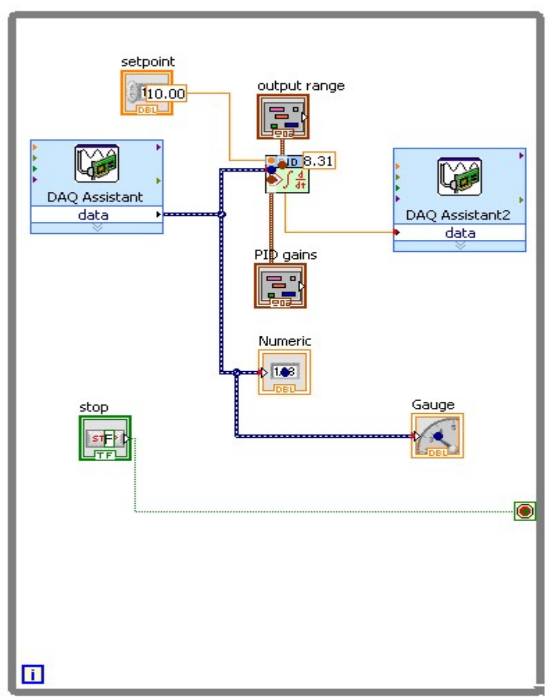

Fig.6.3.Output of 8.31V

VI .CONCLUSION

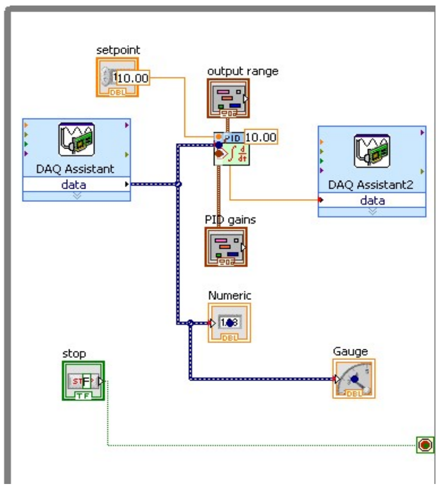

Fig.6.4.Output of 10V

From this project, the problem faced by the open loop system is overcome and the new way control by using Lab VIEW is experimented... The output is varied by automatically without any human interface. So we can able to get the accurate results at the output of 10V by comparing the various processed inputs from the proximity sensor as shown in Fig.6.4.Output of 10.

REFERENCES

[1]. Jovitha Jenome,'Virtual instrumentation using Lab VIEW', PHI learning pvt.ltd, 2010.
[2]. Chance Elliot, Vipin Vijayakumar, 'A programming environment for Laboratory Automation and measurement', SAGE publications, 2007.
[3]. Karl Johan Astros, 'PID controller Theory, Design, Tuning', International society for measurement and control,1995.
[4]. Jeffrey Travis, 'LabVIEW for everyone', Dorling Kindersley pvt.ltd, Pearson education, 1996.
[5]. PID theory explained. Available at http://www.ni.com,2019
[6]. How to connect PNP and NPN sensors. Available at http://www.yoctopuce.com.