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Flow Pump Motor Speed Controller System Using PLC Simatic PCS-7 and PID in PT Sun Paper Source

Giovanni Dimas Prenata
Electrical Engineering Study Program
Faculty of Engineering
Universitas 17 Agustus 1945 Surabaya
gprenata@untag-sby-ac.id

Ahmad Baihaqi
Electrical Engineering Study Program
Faculty of Engineering
Universitas 17 Agustus 1945 Surabaya
ahmadbaihaqi23499@gmail.com

***Abstract*— Motor speed control can be done using PID. Through the PID tuning process on the Simatic PCS 7 PLC, the values Kp = 6, Ki = 45 and Kd = 8 were obtained as parameters for regulating the rotation speed of the pump motor. PID tuning was previously carried out in Matlab by entering the transfer function equation of the pump motor and then obtaining the constant values Kp = 4, Ki = 12 and Kd = 16 through the PID tuning process. The performance of motor speed control using PID (PLC Simatic PCS 7) is not up to target, this is because the PID tuning process takes place simultaneously with the operation of the PLC as the main controller of the production process.**

Keywords—Tunning PID, PLC, Simantic PCS 7 and Matlab.

I. INTRODUCTION

PT Sun Paper Source is a tissue production industry. There are several stages in producing tissue, but the stage of mixing the raw materials that will be molded into tissue is the most important stage. In the mixing process, each material has a standard dose. Mismatch in dosage causes failure in producing tissue.

Each liquid material flows through the pipe in the right volume. The problem that occurs is that the flow of liquid material in the pipe does not match the dosage, causing failure in tissue production. In the old production system, a sensor was used to read the flow of material in the pipe (Flowmeter Sensor). The results of the flowmeter sensor readings become input for adjusting the valve tap. There is a problem with the flowmeter sensor, namely inaccurate reading results which affect the performance of the valve tap. Valve taps also often experience mechanical problems (dead ends) due to material deposits so that the valve tap settings become inaccurate. Apart from these two things (flowmeter sensor and valve tap), the rotation of the pump motor for each pipe is not controlled. Thus increasing the failure rate of tissue production at PT Sun Paper Source.

In this study, researchers used PID to regulate the rotation speed of the pump motor in the pipe so that the volume of material flow was precisely controlled. The flowmeter sensor is used as a reader of the flow speed of production material in the pipe. The results of the flowmeter sensor readings will be processed to calculate the volume of material before mixing. There is a target volume for each material to be mixed. To achieve the target volume quickly and precisely, PID is used to regulate the rotation of the pump motor. PID is found in the PLC which functions as the main controller in the tissue production system. Apart from controlling the flow of material in the pipe, the PLC has a real-time monitoring display (Simantic PCS 7).

PID has been widely implemented in the industrial world, including research conducted by Abdul and Ramadani implementing PID to regulate motor speed with values of Kp = 2, Ki = 0 and Kd = 3.7 resulting in rise time = 2.22 seconds and settling time = 2 .7 seconds [1]. Adri, Titi and Yoakim designed a PID Controller simulation using GUI and Simulik, the results of which can shorten the time to calculate the system response in the S domain [2].

To obtain the constant values of Kp, Ki and Kd, several related studies carried out by Yoga and Tamaji carried out a comparison of the PID tuning method for setting the speed of a Parallel Hybrid Electric Vehicle, with the result that the bat algorithm method had a good performance index compared to other methods [3]. Nasir uses Ziegler Nichols PID tuning to control the angular position of a DC motor with values of Kp = 18, Ki = 0.05075 and Kd = 0.01269 which produces time delay = 0.1242 seconds, rise time = 0.2331 and settling time = 0.3 seconds [4].

This research also uses a PLC to control the entire system, following related research on PLCs carried out by Firdaus and Mia using a PLC to control the starting of an induction motor, and the PLC is proven to be able to control star-delta starting well [5]. Latief, Silowardono, dan Muchlishah menerapkan PLC pada konveyor pemilah barang, dan berhasil memilah barang dengan akurat menggunakan kontrol closed-loop [6]. However, researchers consider using artificial intelligence to determine the rotation speed of the motor based on the volume of each material before mixing. Such as using fuzzy to determine how much volume is needed. Apart from fuzzy, artificial intelligence can be used for classification as done by Prenata in classifying the reliability of electricity distribution networks [7] [8] [9].

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II. METHOD

This research began with a reference exploration of the use of PLCs, VFDs, 3-phase induction motors and Matlab software. PID tuning is carried out in Matlab to obtain constant values of Kp, Ki and Kd which correspond to the transfer function of a 3 phase induction motor. The result of PID tuning is a system response curve based on the constant values Kp, Ki and Kd. The criteria for a good system response are having a low overshoot value, a high rise time, a low steady state error and a low settling time.

The constant values Kp, Ki and Kd obtained through previous PID tuning (matlab) are used as a reference for PID tuning on Simatic PCS 7. Simatic PCS 7 is a display interface for the PLC, so that the results of PLC tuning can be directly implemented to control the rotation speed of the motor. Evaluation and monitoring can also be done directly, making it possible to reconfigure if the previous PID tuning results were not optimal.

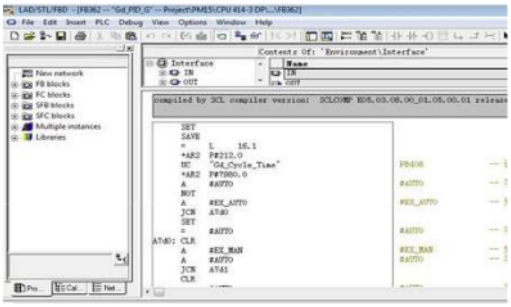

Figure 1. Function Block Simantic PCS 7

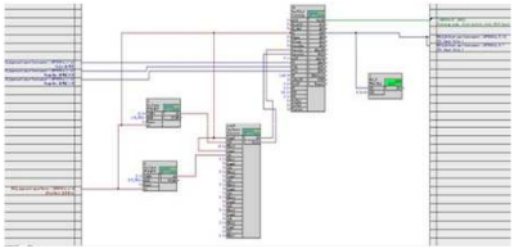

Figure 2. Function Chart Simantic PCS 7

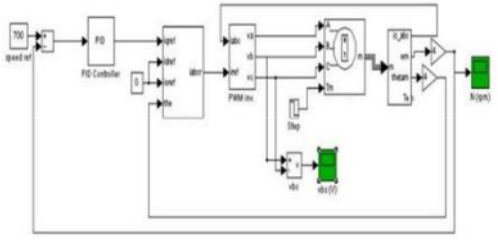

Figure 3. Circuit Model on Matlab

III. PREPARE YOUR PAPER BEFORE STYLING

A. Tuning PID using MatLab

The trial and error method is used for PID tuning in Matlab by changing the Kp, Ki and Kd values by considering the system response curve. By looking at the system response curve, the author tries to achieve low overshoot values, high rise time, low steady state error and low settling time.

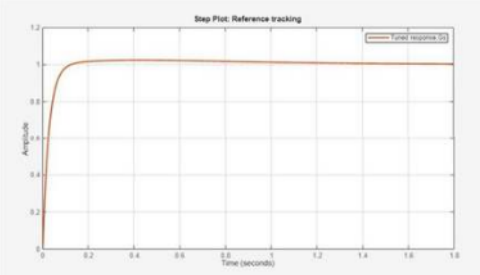

Figure 4. Tuning results using PID Tuner MatLab

In Matlab there is a PID Tunner menu which can help find optimal Kp, Ki and Kd values automatically. PID tuning using the PID Tunner produces values of Kp = 4, Ki = 12 and Kd = 16 whose system response curve has low values for overshoot, rise time and steady state error.

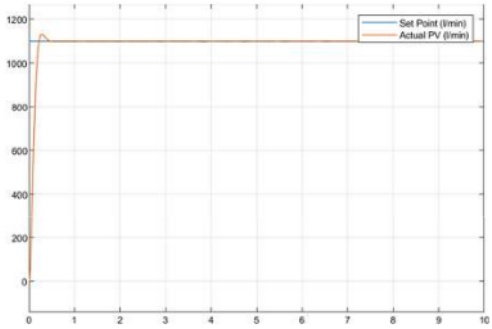

Figure 5. System response using Matlab

After finding the optimal Kp, Ki and Kd values, then calculate the rise time, settling time and overshoot values. In the PID Tunner the parameter values have been calculated, namely Rise Time = 0.0589s, Settling time = 0.644s, Overshoot = 2.3%.

B. Tuning PID using Simatic PCS 7

PID tuning on Simatic PCS 7 uses Kp, Ki and Kd values obtained from Matlab PID tuning. However, this cannot be used because the conditions are not ideal on the Simatic PCS 7. Simatic PCS 7 is a display interface for a PLC that is connected to a pump motor. When the Simatic PCS 7 PID tuning

process takes place, the production process is also running so adjustments need to be made.

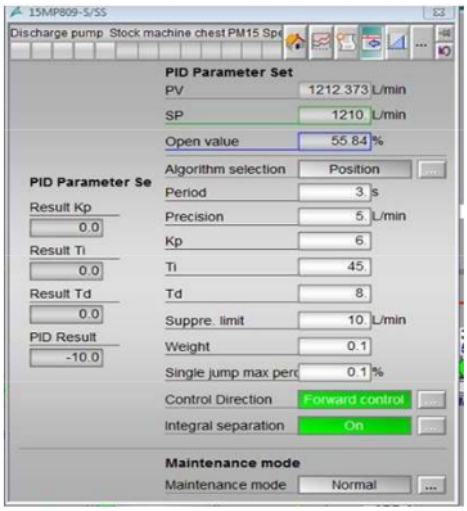

Figure 6. PID Parameters on Simatic PCS 7

The constant values Kp = 4, Ti = 12, and Td = 16 come from Matlab PID tuning. Implementation of PID tunning on Simatic PCS 7 gets values of Kp = 6, Ti = 45 and Kd = 8. The image below is the system response curve resulting from PID tunning on Simatic PCS 7.

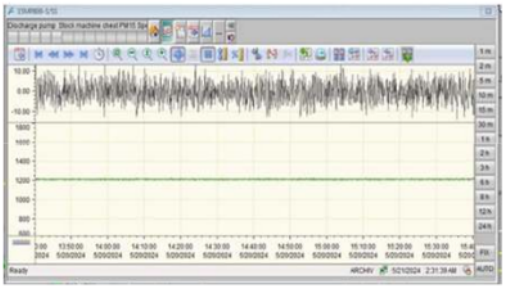

Figure 7. System response on Simatic PCS 7

In the picture above the setpoint speed value is determined at 1210 l/min. This causes the actual speed value to catch up to the set point of 1200-1220 l/min within 40 minutes. The average overshoot and undershoot error signal is around 8-10 l/min.

Table 1. PID tuning parameters on Simantic PCS 7

Name	Hasil Kurva Reaksi
Setpoin Speed SP	1210 l/min
Actual Speed PV	1200-1220 l/min
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

IV. CONCLUSION

PID tuning is a trial and error method to find optimal Kp, Ki and Kd constant values. By using Matlab, we get the constant values Kp = 4, Ti = 12, and Td = 16. Meanwhile, SIMATIC PCS 7 gets the constant values Kp = 6, Ti = 45, and Td = 8. The performance of the pump system that uses a PID controller is still unclear. OK, still needs to be evaluated and improved.

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