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Introduced A Model Of A Water Pipeline Pressure Stabilization System According To Pid

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ABSTRACT
This paper introduces a programming problem for PLC siemens S7-1200 with the following main functions: the first function, Automatically adjusts the pump's speed according to the water pressure on the pipeline using the PID algorithm, based on demand during peak or off-peak hours. The second function, Combination of PLC S7-1200 and WinCC software to build a control system, monitor automatic water pressure stable pump.
Keywords: PLC s7-1200, The PID controller, Mobus RTU communication between PLC and inverter.

I. INTRODUCTION

Water pumping systems in factories, industrial parks and buildings mostly operate continuously at 100% load from start to finish. This causes many limitations and wastes to the system such as:
- When at peak time: the output water needs to be used a lot, even though the system runs at 100% load, it will still not be enough water to supply the plant, leading to water shortage.
- When at off-peak time: the output water is used less but the pump is still running at 100% capacity, leading to waste.
Besides, the water pressure in the pipeline is not stable, there are times when the pressure rises too high, causing damage to the pipeline.
Therefore, the application of PLC and inverter in the control system to stabilize the water pressure for the pipeline is necessary to meet the increasing demands of modern society.

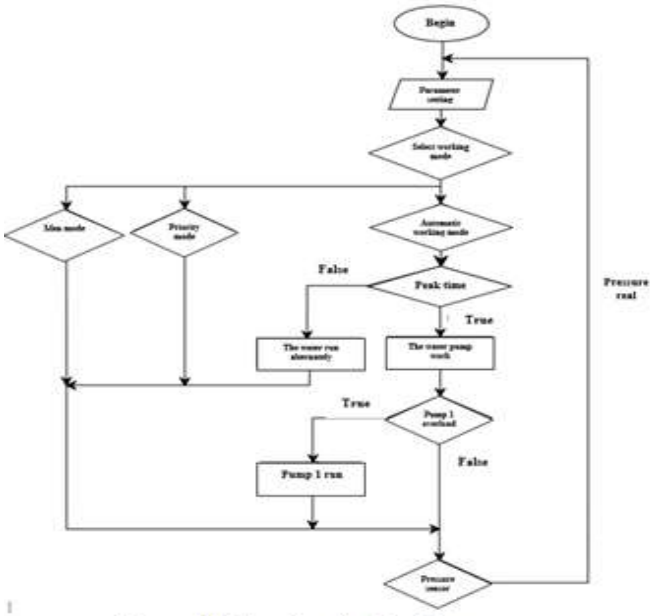

Figure 2.1: The algorithm flowchart

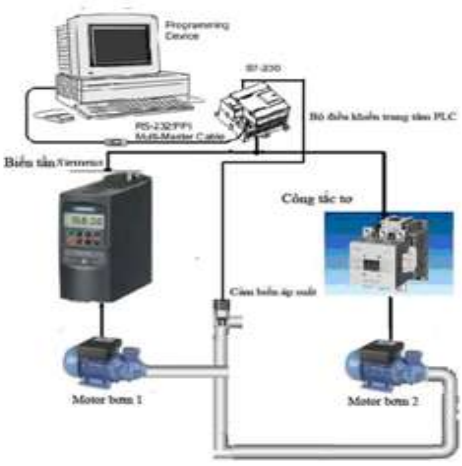

Figure 2.2: The overall structure diagram of the model

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SELECTION OF WATER PUMP MOTOR SPEED CONTROL METHOD

The adjustment of pump water flow is done by methods such as:

- Adjust by closing the valve on the pump discharge pipe.
- Adjustment by opening and closing pumps operating at the same time.
- Variable speed control of pump motor by hydraulic coupling.

The proposed methods do not save electrical energy, because the vibration when opening and closing the valve also damages equipment and pipes, and the supply pumps do not follow the appropriate consumption mode. .

To solve the above problem, a variable speed drive control method can be used with an inverter device. The inverter device is a device that adjusts the rotational speed of the motor by changing the frequency of the power supply to the motor.

The output of the PLC is connected to the inverter to control the inverter and the inverter controls the motor speed. The inverter allows to flexibly adjust the flow and pressure supplied to the network according to the consumption requirements.

Signal from the pressure sensor feedback to the PLC, the PLC will compare the feedback value with the set value to command the inverter to change the speed of the motor by changing the frequency of the power input to the motor. . Make sure the water pressure in the pipeline is stable.

The output of the PLC is connected to the inverter to control the inverter and the inverter controls the motor speed. The inverter device allows to flexibly adjust the flow and pressure supplied to the network according to the consumption requirements.

Signal from the pressure sensor feedback to the PLC, the PLC will compare the feedback value with the set value to command the inverter to change the speed of the motor by changing the frequency of the power input to the motor. Make sure the water pressure in the pipeline is stable.

ANALYZING THE TECHNOLOGICAL PROBLEM OF THE WATER PIPE PRESSURE STABILITY MODEL

Using a smooth control inverter for the pump motor, the motor's power consumption will be adjusted by the inverter to suit the needs of the load. The pressure sensor is used at the pump's water supply outlet to measure the water pressure returned to the controller.

The controller is a PLC that ensures complete automation of the pumping process. System operation and monitoring via WinCC. The system is controlled manually or automatically on WinCC.

Using an inverter to adjust the pump speed will help keep abreast of the actual flow of the load, significantly reducing unnecessary energy consumption at off-peak hours.

The system will automatically monitor the water pressure on the pipeline and control it back to ensure the correct pressure is kept as required. The PLC will control the water pressure on the pipeline according to the daily load graph, ie the system will control the pressure in real time.

The algorithm flowchart as follow Figure 2.1 and the overall structure diagram as follow Figure 2.2:

SELECT DEVICE IN THE WATER PIPE PRESSURE STABILITY MODEL

Selection of PLC and modules as follow in Fingure 3.1.

Figure 3.1: PLC and Moduls

Selection of Inverter as follow in Fingure 3.2.

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Figure 3.2: Inverter Mitshubishi FR E700

Figure 3.3: The other auxiliary equipment

Selection of the other auxiliary equipment as follow in Fingure 3.3.

Figure 3.4: Finishing the control cabinet

THE CONTROL PROGRAM ON PLC S7-1200 AND MONITOR ON WINCC

The S7-1200 PLC's PID controller has the function of synthesizing the input signal, by comparing the set signal and the feedback signal. From there, the output signal is adjusted to achieve optimal quality criteria. The S7-1200 PLC's PID controller is divided into 4 types of instructions, with different functions and use cases.

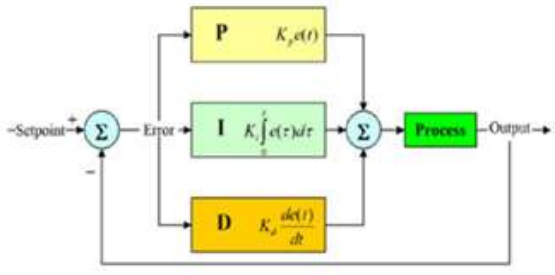

Figure 4.1: Structure of the PID controller

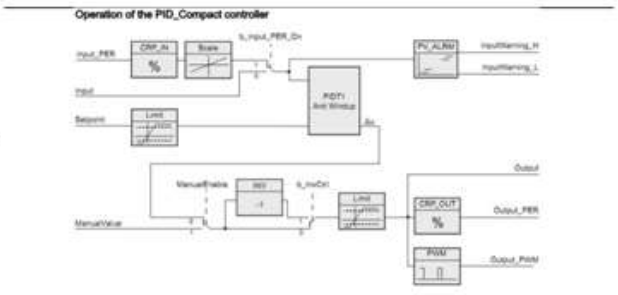

Figure 4.2: Structure diagram of the PID controller of PLC S7- 1200

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The structure diagram of the PID_Compact controller of the PLC S7-1200 is presented as shown and the working block diagram of the PID_Compact block is shown in the figure 4.1.

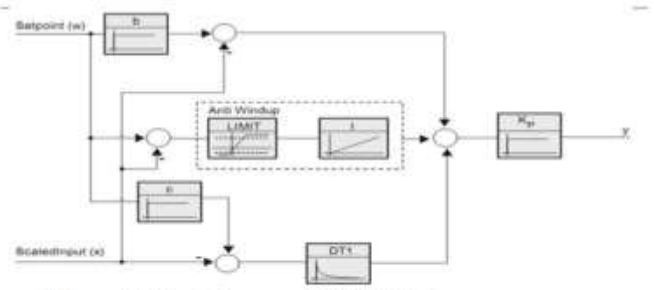

Figure 4.3: Block diagram of PIDT1 Anti Windup in the PID controller of PLC S7- 1200

Figure 4.4: Working block diagram of PID_Compact PLC S7 1200

The setting of PID_Compact controller parameters is required to stabilize the water pipe pressure.
The program to control the water pipe pressure stabilizer model is written in Lad language on the PLC S7-1200 and monitored on WinCC.

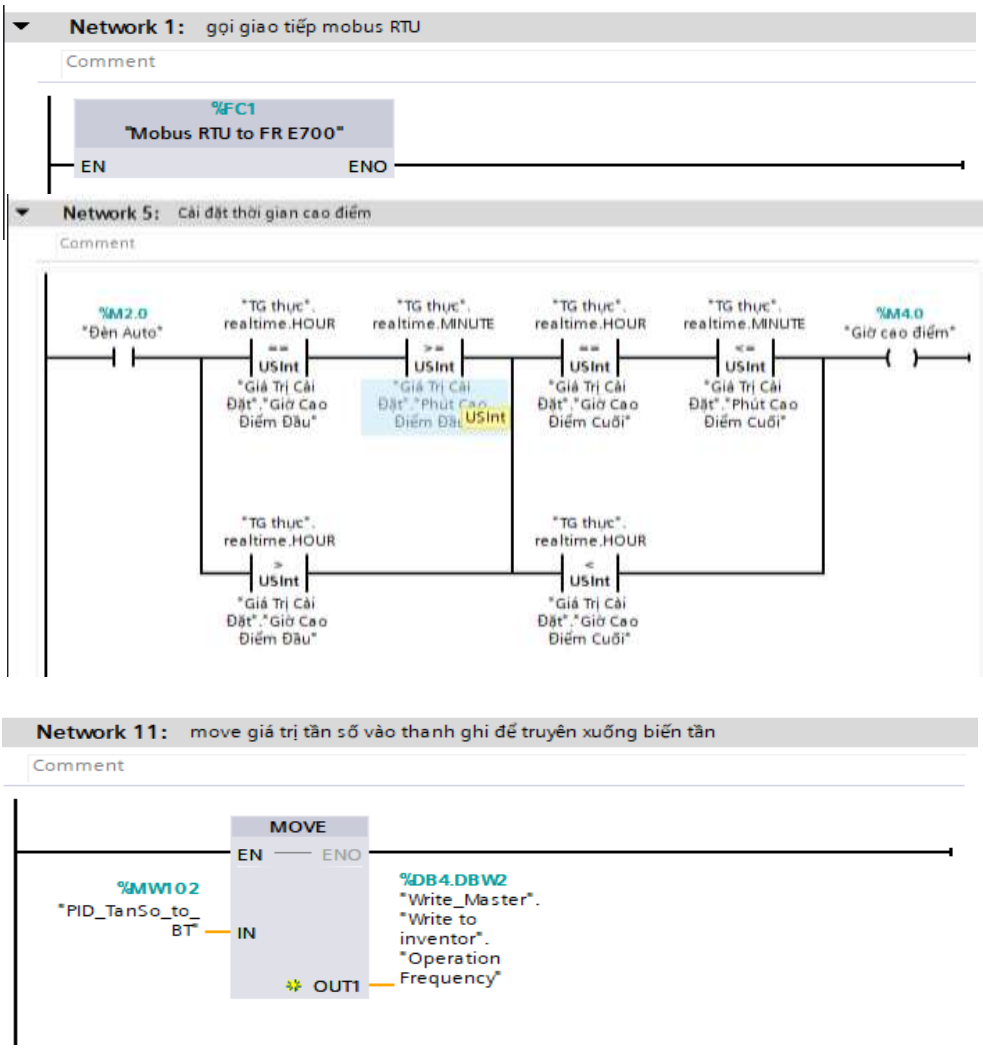

Figure 4.5: The example networks

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The installation and operation of the system is done by WinCC software. WinCC interface includes 3 working screens: mode selection screen, working parameter setting screen, output parameter display screen and system response graph.

Figure 4.6: The hello screen

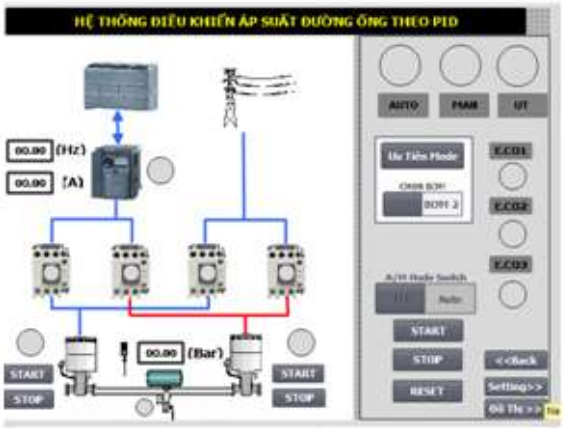

Figure 4.7: The mode selection screen

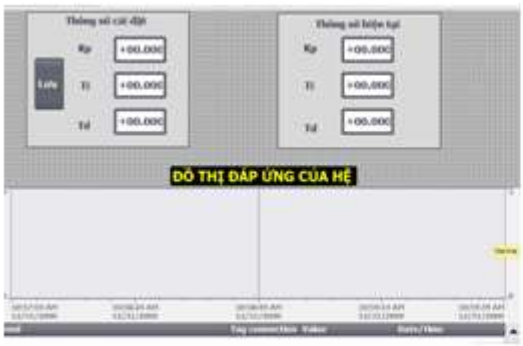

Figure 4.8: The working parameter setting screen

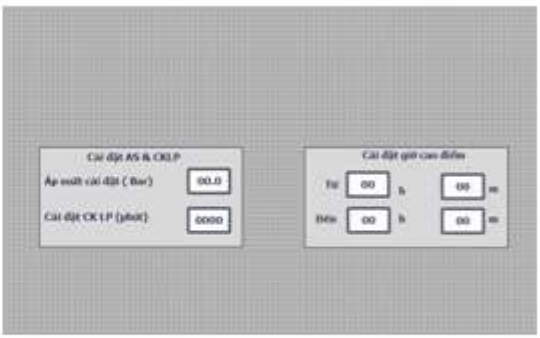

Figure 4.9: The output parameter display screen

II. CONCLUSION

The model automatically adjusts the pump's speed according to the water pressure on the pipeline, depending on the consumption demand during peak or off-peak hours, using the PID block in PLC s7-1200. Stable model water pipe pressure stable operation, high accuracy.

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