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Application Of PID Controller Using Mitsubishi PLC For Water Tank System

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Abstract:.
The paper presents the implementation of the automatic water leveling system, which can be applied in related companies in food, chemical, and water treatment. The testing system includes standard equipment in industry such as a three-phase motor, ultrasonic level sensor, and Mitsubishi FX PLC controller. The water level in the tank, is balanced control based on the PID controller, which automatically detects the optimal parameters for the real system. Experimental results highlight that the system operates stably and accurately. Thus, the implemented water balance system has a hight applicability in the practice.
Keywords*: PID controller; water balance systems; Mitsubishi FX.*

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I. INTRODUCTION

The issue of management of liquids such as water, oil, gasoline, sewage as well as how to make efficiency is a matter of many people and organizations interested in the current era. The topics on design of water balance system in water tank are very interesting and attracts many technician, practitioners, and engineers. These systems are applied extensively in the fields of industry such as agriculture, chemistry, and civil engineering. In particular, in many companies, enterprises and factories, the water balance system has been playing an important role in monitoring and justifying the fluid in many various applications.

There are many methods to monitor and manage liquids, including manual methods and automatic control techniques. Nowadays, the method of liquid monitoring and management has been completely automated to reduce human labor and increase the productivity as well as flexibility in many enterprises.

To control and monitor the water level in the tank, the most efficient implementation method is ultilization of the PID controller. Understanding and implementing the PID controller is difficult because the actual systems are hard to do with the standards that we have previously calculated. Detection of the PID parameters for systems of the same type but varies in size, device parameters are also difficult and need skillful men in this regard. This study provides standardized steps to help readers in building the PID levels of water balance in the tank easily

Method of implementing the hardware system

The block diagram and hardware design of the system is shown in Figures 1 and 2

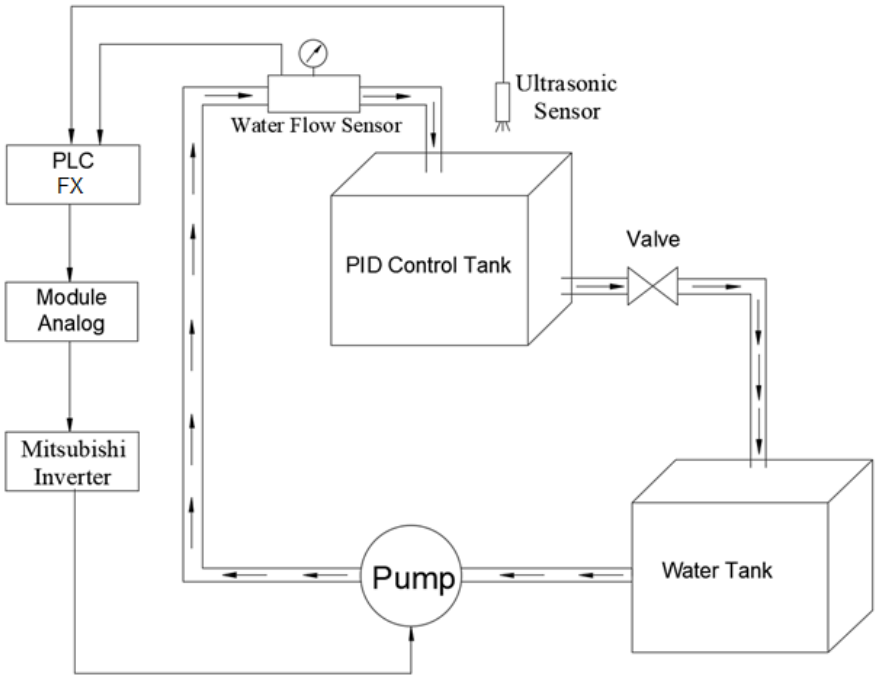

Figure 1: System block diagram

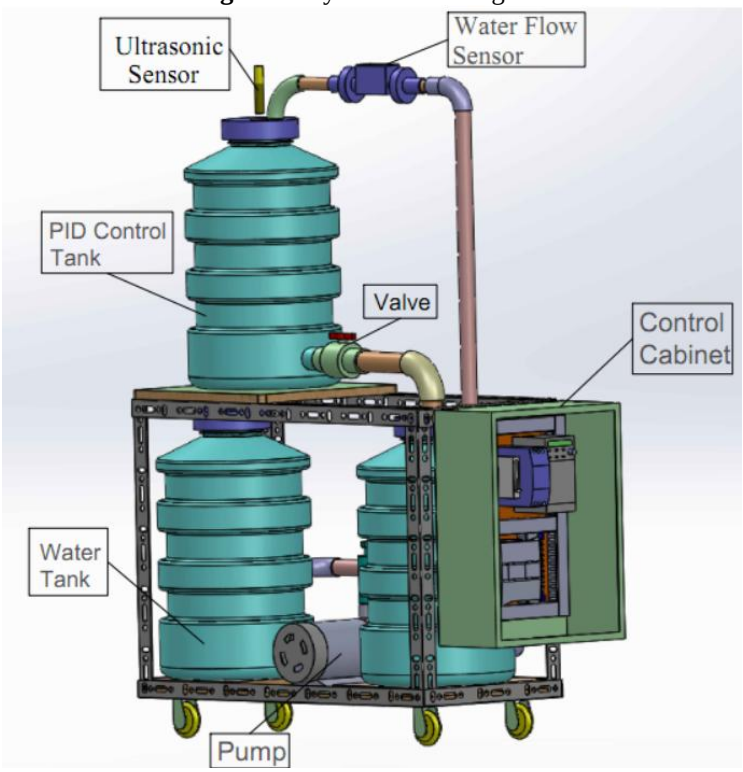

Figure 2: System hardware design

Part model frame: the model frame is designed compact. The entire frame is made from iron shaped V makes the system strong and easy to execute. Below are four wheels that make it easy to move the system on the ground or the workshop floor.
Water tank system: It consists of 20 liter bottles in clear form and can observe the water level in the bottle. Several computation of determining the tank is based on [2].
Ultrasonic sensor: Measuring distance from 3 to 30 cm, voltage output as 0 - 10V
Water flow sensor: Measuring range from 0 to 60 liters / minute, voltage output as 0 - 10V.
Water pump motor: 3 phase 220V motor type, capacity 200W, maximum flow 60 liters / minute
Mitsubishi inverter: Capacity of 200W, controlling motor of water pump motor

Central controller: FX3U PLC controller plays the role of controller with the following functions:

- Receive Analog signals from the sensor to determine the water level in the control tank and the water flow after passing through the pump
- Calculate PID values and output signals to Analog output module to control the inverter changing the water pump flow.

Auto-tuning function of PID instruction: The auto-tuning function will automatically set the important constants, such as the proportional gain and the integral time, to ensure optimum PID control.

Auto-tuning procedure (limit cycle method):

- Set the forward or backward operation
- Select the auto-tuning method (limit cycle method)
- Set the auto-tuning execution flag to ON
- Set the input filter
- Set the sampling time
- Set the Upper Limit Value
- Set the Lower Limit Value
- Set the threshold (hysteresis)
- Set the target value (SV)
- Set the ON PID instruction command input to start auto-tuning

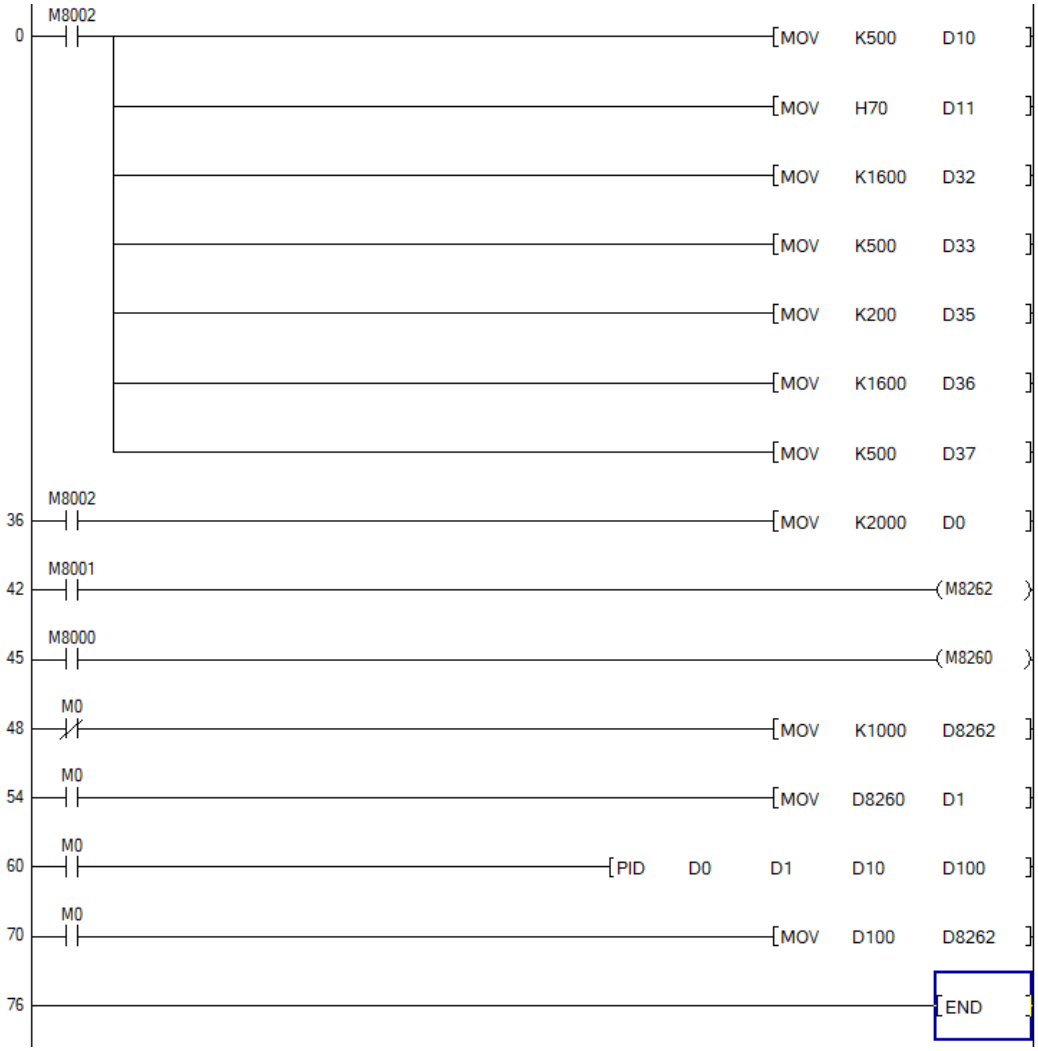

Figure 3: PID program

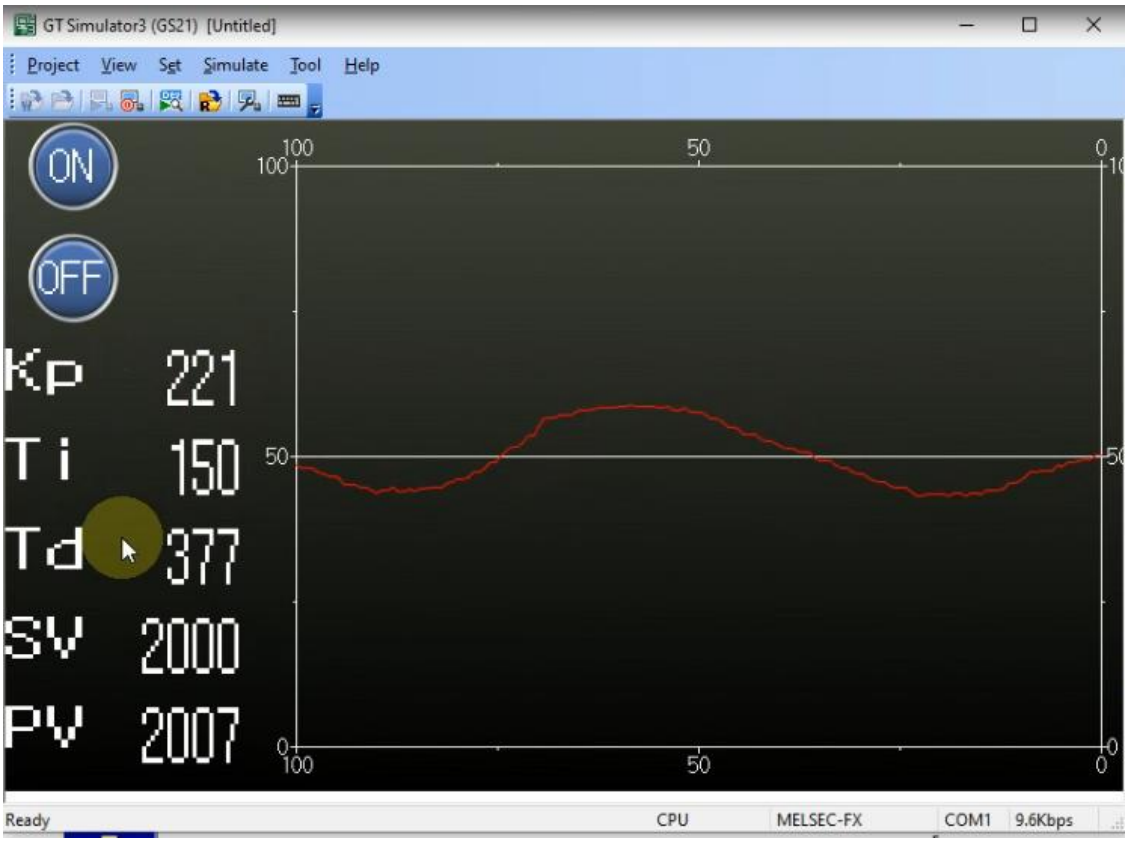

Figure 4: Detection of PID parameters

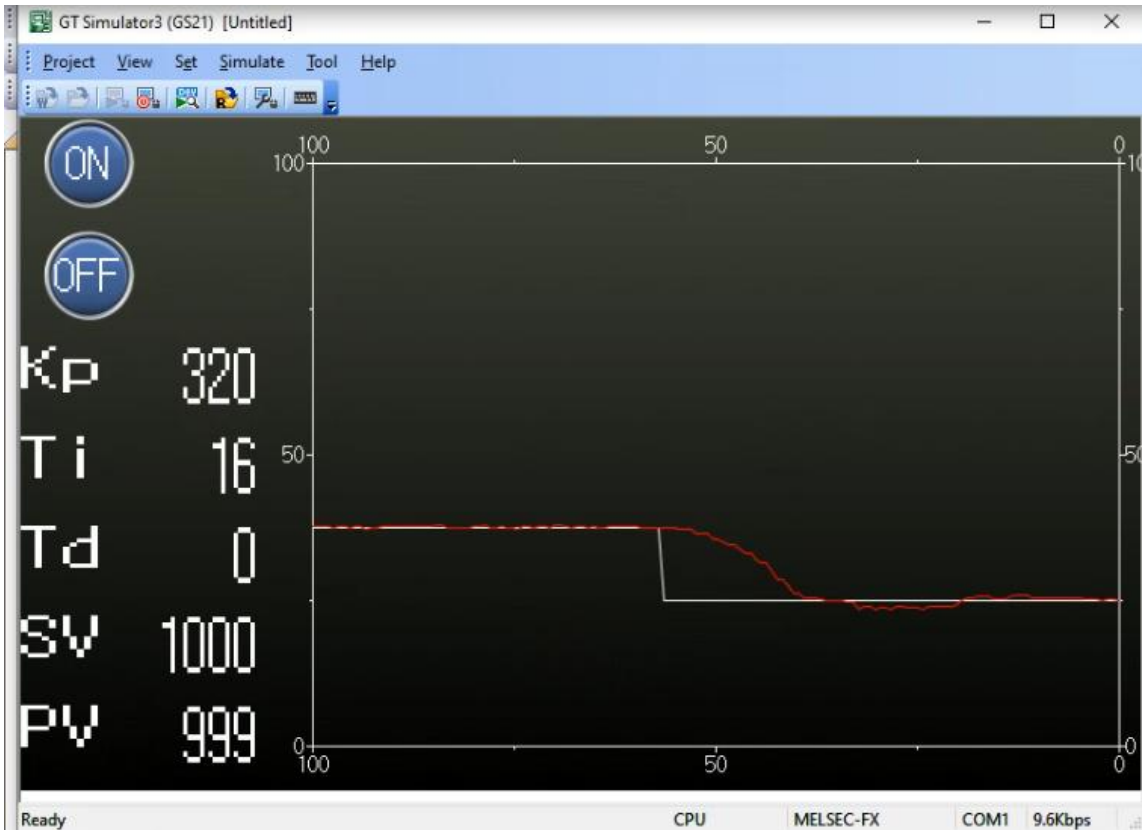

Figure 5: Experimental test of models

II. CONCLUSION

The article provides standardized steps to help readers build a system of water levels in the tank easily by applying the available industrial control devices to reduce the dependence on the high-tech work force. Experimental models are built to work well with the requirements. The PID controller parameters are detected automatically, reliably and quickly.

REFERENCES

[1]. Mitsubishi FX PLC Manual.
[2]. Robert L. Mott (2014). Applied Fluid Mechanics. Pearson.

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