Laboratory Exercise 5 (Wk 6)

Tank over Tank

Introduction

This lab includes a tank over a tank with two drain valves between the two. A bilge pump transfers water back to the top tank from the reservoir at the bottom. A flow meter reports the flow of water from the bilge pump. Two additional flow meters report flow out of the upper tank.

Purpose of the Lab – From experiences in industry, one individual stated that an auto controls course need only teach students to tune outer loops slow and inner loops fast to be successful with instrumentation applications. This stuck with this author and there has always been desire for students to have such an experience with a visual loop within a loop.

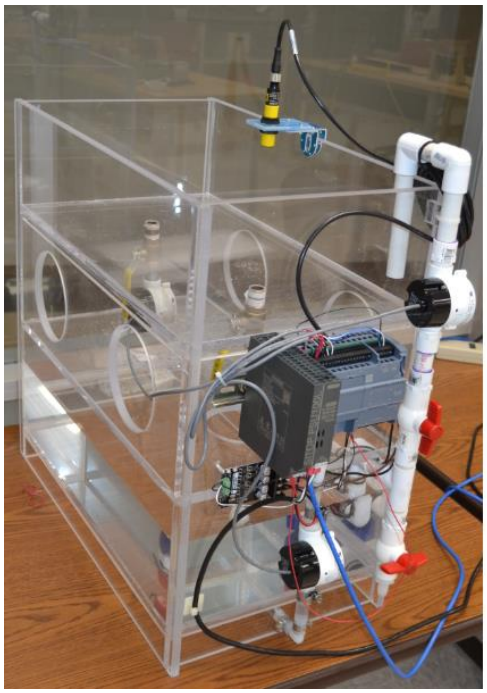
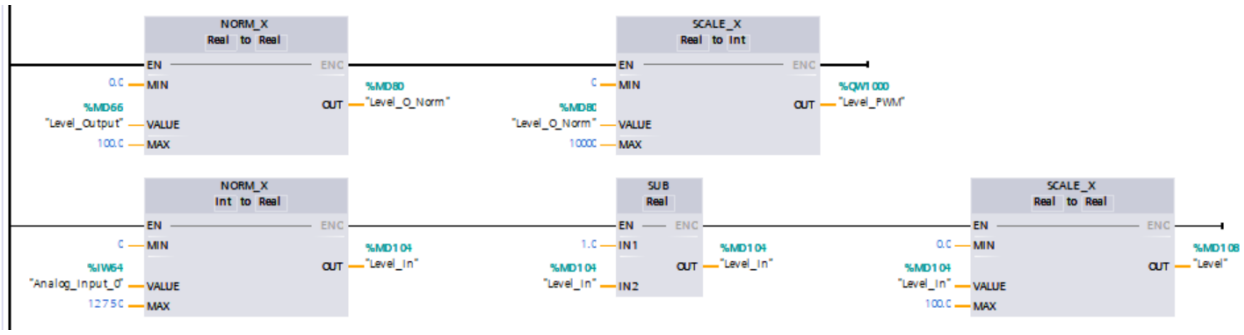


Fig. 5-1

Procedure:

First, look at the program below (pg 2-3). It will be loaded in a later step into the processor. How it works will be the primary focus of the lab. We looked at the calibration of the level sensor in Lab 3. Review the information from this lab and find the input value in the program (IW64). Then review your values in mm or inches for the level at various heights.



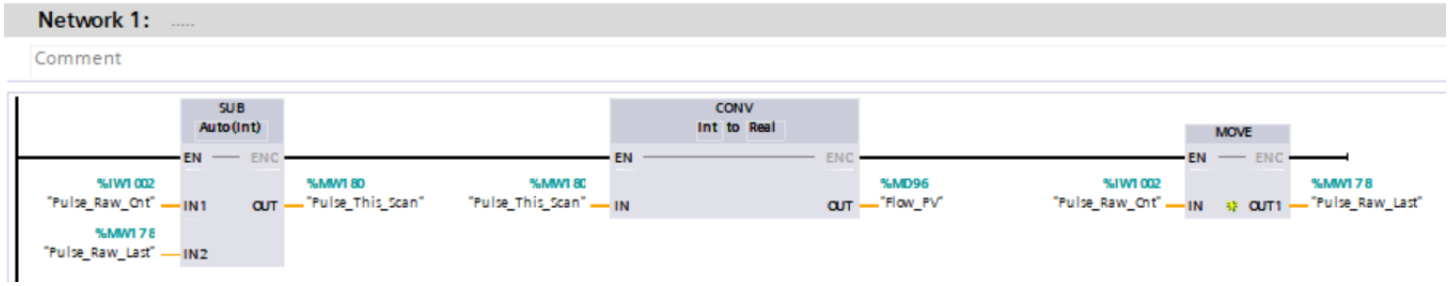
Add statements to create a variable called Level_mm or Level_in that represents the actual height of the water in mm or inches. The variable should be a multiplied value of 'Level_In'. 'Level_In' is a variable that has the range of 0-1. Also, verify that the max and min values of IW64 are actually 12750 and 0. Otherwise, change these values in the NORM_X instruction.

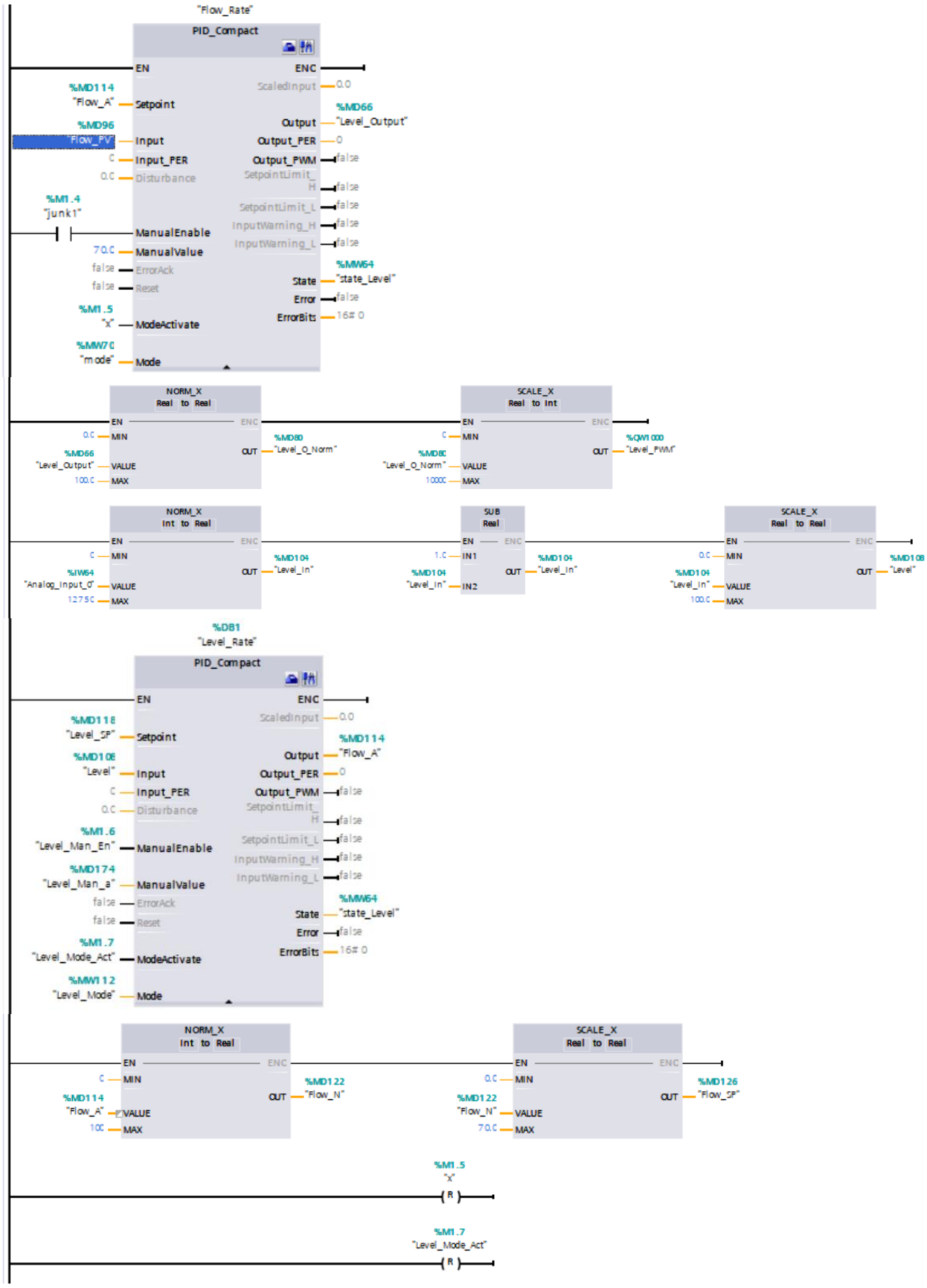
The 'Flow_PV' variable is the input variable to the Flow PID block. It is derived from a pulse input found linked to a digital input terminal. The High Speed Counter associated with this input counts pulses based on flow through a paddle wheel. The HSC gives a count since last read. The PID block executes each 100 msec. For 100 msec, the maximum pulse count is equal to 5 liter/sec.

To change setpoint, use a watch table and modify 'Flow_SP'. It should be in the range of 0-100.

Next, you may use the tuning parameters entered in the program as it exists. Then adjust the parameters to slow the inner loop (flow) and increase the outer loop (level) to achieve instability in the system. This action shows the importance of coordination of loops with inner loop fast, outer loop slow. Record the values you found that made the level loop unstable.

Program Statements:




"Flow_Rate"
PID_Compact
EN
ENC
%MD114
"Flow_A"
Setpoint
ScaledInput
0.0
%MD66
"Level_Output"
Output
%MD96
Flow_PV
Input
Output_PER
0
Input_PER
Output_PWM
false
0.0
Disturbance
SetpointLimit_H
false
%M1.4
"junk1"
SetpointLimit_L
false
InputWarning_H
false
ManualEnable
InputWarning_L
false
70.0
ManualValue
%MW64
"state_Level"
false
ErrorAck
State
false
Reset
Error
false
%M1.5
"X"
ModeActivate
ErrorBits
16#0
%MW70
"mode"
Mode
NORM_X
Real to Real
SCALE_X
Real to Int
0.0
MIN
%MD80
"Level_O_Norm"
OUT
%QW1000
"Level_PWM"
%MD66
"Level_Output"
VALUE
100.0
MAX
10000
NORM_X
Int to Real
SUB
Real
SCALE_X
Real to Real
%IW64
"Analog_Input_0"
12750
%MD104
"Level_In"
1.0
IN1
IN2
%MD108
"Level"
%DB1
"Level_Rate"
%MD118
"Level_SP"
%MD108
"Level"
%M1.6
"Level_Man_En"
%MD174
"Level_Man_a"
%M1.7
"Level_Mode_Act"
%MW112
"Level_Mode"
%MD122
"Flow_N"
%MD126
"Flow_SP"
R

Cytron 20Amp Bi-Directional 6V-30V DC Motor Driver Speed Controller 60A Peak

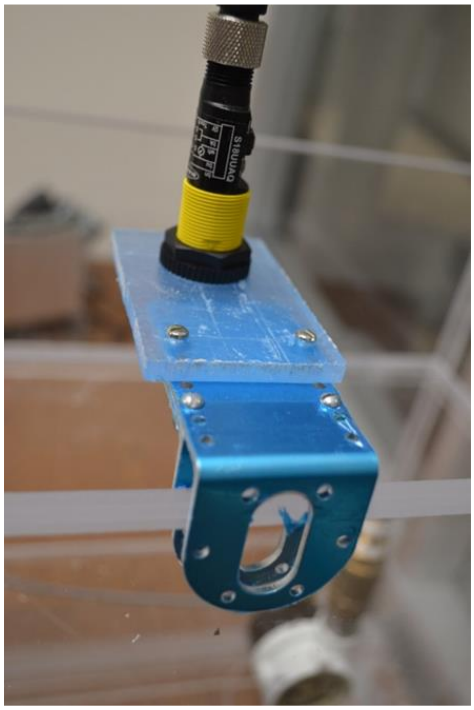
★★★★★ 12

$19.80

FREE Shipping

Only 14 left in stock - order soon.

Rule 500 GPH Bilge Pump, 24 V Input, Submersible



Compact ultrasonic sensor Banner Eng - S18UUAQ

- Senses from 30 to 300 mm
- Available in analog or discrete models
- Features minimal dead zone and eliminates dead zone if used in retrosonic mode
- Ideal for material handling and packaged goods applications, such as bottling or liquid level detection and control for small containers
- Available in straight or right-angle versions with a wide variety of mounting hardware for enhance sensing versatility
- Offers programmable background suppression
- Compensates for temperature, for greatest sensing accuracy
- Simplifies setup with push-button and remote TEACH-mode programming
- Shows status during setup and operation, using highly visible LEDs indicators

Gems Sensors 155481 RFO Series Flow Rate Monitoring Sensor

Brand: Gems Sensors

1 rating

Price: $110.00 prime & FREE Returns

- Body Material: Polypropylene
- Port Size: 1/2" NPT Female
- Flow Range (GPM): 1.5-20.0
- Low Flow Accuracy: +/- 7%
- Standard Flow Accuracy: +/- 15%

$110.00

prime & FREE Returns

FREE delivery: **Tuesday, April 13**
Order within 3 hrs and 22 mins
Details

Only 13 left in stock (more on the way).

Qty: 1

Flow Range 4.0 - 20.0 GPM:

20 GPM equals an input range of 56 pulses in 100 msec which is the Flow_PV variable in the program. Create a variable that represents the actual flow rate and is a multiplier of Flow_PV. Add a multiply block in the program to generate this variable.

Also, calculate the accuracy of this variable. Note the accuracy of the signal in your report.

View the flow variable as well as the Level variable in the Watch Table with the PID blocks running in Auto.

Save the program with modifications for use in Lab 7.

Electrical Engineering Technology

Lab Report Grade Sheet

Name/Date _____

Course: EET 4450

Lab Laboratory Exercise 5 – Tank over Tank

Grading Element	Maximum Points	Your Points
Objective	10%	
Procedure	10%	
Results	20%	
Discussion	20%	
Conclusion	30%	
Spelling/ Grammar	10%	
Total	100%	

Comments: _____

_____

_____

_____

_____

Instructor: _____

Objective, Procedure, Results:

Conclusion

Discuss the results or your lab and show how the objectives were met. If there were substantial differences or similarities between how the two controllers did a specific task, comment on your observations.