

2225872

by Ellis Dickeson

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Bibliography

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<https://ladderlogicworld.com/ladder-logic-basics/#:~:text=Ladder%20diagrams%20are%20used%20to,t.,n.d.s.l.:s.n.>

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[This belongs as part of the citation list at the back](#)

1. Work Plan for Lifelong Learning

In order to complete this assignment research will be carried out into five IEC languages to the PLC programmer. Images will also be used to illustrate each language in the appendix. All the research that is found will be Harvard referenced. Next, a hardware design will be created along with an input and an output list including all the addresses for the inputs and outputs used in the program. Once this is completed, a program design and explanation will need to take place where a TIA project will be created that includes the PLC and HMI screens with suitable IP addresses. The program will contain suitable function calls, function blocks and cyclic interrupts. There will be manual controls for filling and emptying the tank, a semi-automatic control of level using the PID control method with a setpoint for level, there will also be a semi-automatic control of flow and allow the engineer to choose tuning values for PID control and lastly there will be a full automatic mode so that when initiated, the tank should fill up to a fixed level after which flow control should begin and run at a setpoint flowrate. When the automatic is stopped, the tank should be drained. Once the project is created, simulation testing will take place where a table is created in order to prove whether the project created all works to how it should and that there are no problems with the program. Taking into consideration that the system meets the customers' needs.

A good work plan

2. Research

Write in the third person

In programming a PLC, there are 5 IEC languages which can be used to create your functioning program. These are Ladder Diagrams (LD), Function Block Diagram (FBD), Sequential Function Charts (SFC), Structured Text (ST) and lastly Instruction List (IL).

The reason ladder diagrams are used in programming a PLC is simply because of the fact that they are used to “formulate PLC logic expressions in graphical form” said Steven. What Ladder Diagrams do is they use symbols to replicate the input and output expressions. Another reason for ladder diagram to be used in programming is because of the simplicity of their programming in comparison to text-based programming languages. (Steven, 2021)

Ladder diagrams are one of the PLC standard uses. A ladder diagram in a program is a circuit diagram that imitates circuits of relay logic hardware. (Schneider electric, 2022)

The second type of IEC used in programming a PLC was Function Block Diagrams. The reasoning for function block diagrams to be used is because an FBD are objects which are defined in a PLC program to “simplify the process of programming”. Basically, meaning that it will reduce the length of the program and the complexity of it written by the programmer. (Viral Nagda, 2021)

The purpose of a Sequential Function Chart is that it can be used to structure the internal organization of a program consisting of secondary programs. A Sequential Function Chart makes it simpler to program the sequential aspect directly in the PLC. During the SFC being written there are multiple steps going to take place and each graphic symbol represents a singular step. A step is the exact same as a state. (Tom Mejer Antonsen, 2022)

When programming a PLC, structured text is a vital part of it. The reason for using structured text is it allows the person creating the program to create complex routines and flows that could possibly not always be as simply implemented in Ladder Diagrams. In Structured Text it would take a single line of code to implement in ST, while in Ladder Diagram it requires a different routine. (Anon, 2015)

The final IEC language is Instruction List. The Instruction List IEC is a shallow level text language used in PLC systems, which has a similar structure to a simple machine assembler. An Instruction List can provide a program with each instruction on a line below which is used as a sequence of instructions. With an Instruction List in place, the inputs will be read and then the next step is the program instructions are executed after which diagnostics and any needed communication occurs and then lastly, the output is generated. (Anon, 2019)

*Your descriptions above should have made reference to the figures in the appendix
You haven't chosen a language*

3. Hardware Design and I/O List

INPUTS	OUTPUTS
Factory IO Running DI %I0.3	Fill Valve AQ Real %QD30
Level Meter AI Real %ID30	Drain Valve AQ Real %QD34
Flow Meter AI Real %ID34	Start Light %Q0.0
Start Button %I0.0	Reset Light %Q0.1
Reset Button %I0.1	Stop Light %Q0.2
Stop Button %I0.2	Setpoint Panel Meter %QD38
Setpoint Potentiometer %ID38	Process Variable Panel Meter %QD42

Write in the third person

The system used for this assignment is the S7 PLCSIM. With this system you can do many things such as simulate a CPU program on a virtual controller. This system does not require any real controllers in order to create a functioning program. The program can be configured in STEP 7 on an app called TIA Portal. In order to create a system that works efficiently what's needed to be done is programming the application logic and then to load the hardware configuration and the program into the virtual controller. Doing this, you also need to compile your system in order to fault find any problems that occur during the compiling of the system.

4. Program Design and Explanation

In this program, a TIA project will be created that will include the PLC and HMI screens suitable IP addresses for each component. Once this is completed a PLC tag list will be built in the program with necessary memory elements and data blocks. Following this, the PLC program will have to be structured with the suitable function calls, cyclic interrupts and function blocks. After completing this, the most suitable IEC languages will need to be used for each individual parts of the program as have previously explained in the research section of this assignment in order to meet the customer's requirements. Once all this is completed the next step is then to provide manual controls for filling and emptying the tank with indications of the current status of all the devices used. Subsequently, a semi-automatic system for the control of level in using the PID control method which has a set point for level. It will also need to allow the engineer to be able to choose tuning values. After completion of this, the program will need to provide a semi-automatic control for the flow of the tank and also enable the engineer to select tuning values for the PID control. The program will also need a full automatic mode which will have to be written in auto sequence (SCL) so that when started, the tank should fill up to a set point level. After this occurs, the flow control should begin and run at a set point flowrate. The program should also be set to drain the tank once the automatic mode is stopped. To complete the program, HMI screens need to be available to provide data and trend graphs with screens of each mode showing where the flow and level is currently sat at. An operator screen will need to be created which will have the auto-mode start and stop buttons with mimic bar graphs for level and flow of the tank.

Describe what you have produced, don't tell a story.

5. System Testing

An excellent table

Test Description	Expected Results	Actual Results	Decision	Evidence
Flow start button	Should start the flow into the tank	The tank started to flow	Passed	Figure 6
Flow stop button	Should stop the flow into the tank	The flow stopped	Passed	Figure 7
Level start button	Should start level meter	The level meter started	Passed	Figure 8
Level stop button	Should stop level meter	The level meter stopped	Passed	Figure 9
Flow manual and semi-automatic mode	The flow should only be in either of the modes	When pressed the flow stayed in one mode	Passed	Figure 10 Figure 11
Level manual and semi-automatic mode	When the button is pressed it should only stay in one mode not both	When pressed the level stayed in one mode	Passed	Figure 11 Figure 12
Auto-mode	When pressed, only auto mode should be active	This was the only mode active in program when pressed	Passed	Figure 13
Manual mode				
Level manual increment valve	When pressed it should open the valve to allow the tank to fill more	Opened the valve to fill more	Passed	Figure 14
Level manual decrement valve	When pressed it should close the valve more and more so that it fills less	Valve closed more and more to fill less	Passed	Figure 15

Flow manual increment valve	The valve should open more and more allowing more flow	Every time pressed it opened the valve more to allow more flow	Passed	Figure 16
Flow manual decrement valve	The valve should close more and more allowing less flow	Every time pressed it closed the valve more and more restricting the flow	Passed	Figure 17
Flow valve textbox	Should show the value of how much the flow valve is opening on a scale of 1-10	Displayed the valve on how much it was opening	Passed	Figure 17
Level valve textbox	Should show the value of how much the level valve is opening on a scale of 1-10	Displayed the valve on how much it was opening	Passed	Figure 17
Level textbox	Should display the rate of flow	Showed the rate of flow on screen	Passed	Figure 17
Flow textbox	Should display the rate of level	Displayed the rate of level on the screen	Passed	Figure 17
Flow control (semi-auto mode)				
The graph	The graph should show the flow of the tank	Showed the flow of the tank	Passed	Figure 18
Kp/Ki/Kd box	Should be able to adjust and display	Can be both adjusted and displayed	Passed	Figure 18

CV textbox	The value should come up in the text box	The value was displayed	Passed	Figure 18
Sp textbox	The value should come up in the text box	The value was displayed	Passed	Figure 18
Error textbox	The value should be displayed in the text box	The value was displayed	Passed	Figure 18
PV textbox	The value should be displayed in the text box	The value was displayed	Passed	Figure 18
PI D part boxes	The value should be displayed in the text box	The value was displayed	Passed	Figure 18
Level control (Semi-auto mode)				
The graph	The graph should show the flow of the tank	Showed the flow of the tank	Passed	Figure 19
Kp/Ki/Kd box	Should be able to adjust and display	Can be both adjusted and displayed	Passed	Figure 19
CV textbox	The value should come up in the text box	The value was displayed	Passed	Figure 19
Sp textbox	The value should come up in the text box	The value was displayed	Passed	Figure 19
Error textbox	The value should be displayed in the text box	The value was displayed	Passed	Figure 19

PV text box	The value should be displayed in the text box	The value was displayed	Passed	Figure 19
PID part boxes	The value should be displayed in the text box	The value was displayed	Passed	Figure 19

6. Meeting the Customer Needs

Don't instruct your reader

Once this program has been fully developed and tested, it's essential to gather feedback from real users to ensure that it meets their needs and expectations. In this scenario, I would work with a small group of individuals who would act as my customers and users. Through open discussions and active listening, we would identify any areas of improvement or additional features that could be added to the program. By working as, a team, we would be able to ensure that the program meets the customer and user needs. We would also discuss how to maintain the system's reliability by implementing regular updates and testing procedures to identify and fix any bugs or issues that arise. Testing would be an essential part of the process to ensure that the program is functioning as intended and that it meets the user's expectations. We would test the program in different environments and scenarios to identify any potential problems and ensure that the program is user-friendly and easy to use. Through this team working process, we would be able to identify any areas for improvement and ensure that the program is reliable, efficient, and meets the needs of the user. Ultimately, this would result in a program that is successful and effective.

Write in the third person

What were the customer needs, how do you know you have met them?

7. Conclusions and Recommendations

In conclusion, I believe that this assignment was mostly successful and somewhat unsuccessful. The reasoning that I have for this is that I have created a TIA project with a PLC and HMI screens with suitable IP addresses. I have also created a PLC tag list along with the necessary memory elements with data blocks. My PLC has been structured with the correct function calls, function blocks and cyclic interrupts. I have also used the most suitable IEC language for each part of the program that are going to meet the customer / user's needs. In addition to this, I have been able to provide manual controls for filling and emptying the tank with indications of the current status of all the devices. I have also been able to create a semi-automatic control of level using the PID control method with a set point for level and provided a semi-automatic control of flow whilst allowing the engineering to choose tuning values for PID control. Ultimately, I have been able to create HMI screens that can provide data and trend graphs to assist the engineer in tuning the loops. An operator screen has also been created which contains the auto mode START and STOP buttons with mimic bar graphs for both level and flow. With all this in mind, I think that this assignment has been successful to a degree. The only problem that I have with my program is that I have been unable to create an auto mode sequence. Meaning that my program will not work in auto mode and only will work in semi-auto and manual mode. If this task was to be completed again, what I would do to improve my program is to compare with my peer's sooner in order to be able to create the hardest part of the program with assistance. I believe that I have a very good understanding of this assignment as shown in my research and the program design and explanation sections of it. I have also gained valuable knowledge on the five different IEC methods used in PLC.

Write in the third person

8. Team Working

Working in a team can have a significant impact on the success of a software project. By bringing together individuals with different skill sets and perspectives, teams can generate innovative solutions to complex problems. Collaboration and communication among team members can help to identify and address issues early on, resulting in a higher quality final product. Additionally, working in a team can help to distribute workload more effectively, ensuring that tasks are completed efficiently and on time. Ultimately, the collective effort of a team can lead to a more successful and effective program. The individual that I worked with in order to create a more reliable program was very helpful. He helped me point out a couple of problems with my program and was very patient in doing so. The main problem that I had with my program was that my tank wouldn't fill when in manual mode. With the help of my partner who had a fully working program, we were both able to fault find the problem by narrowing it down to what could be causing my tank not to fill. By looking over his program in detail and checking each of the tags that he had for all the components we found that my tank tag was tagged to the incorrect tag. Once this was corrected to the right tag, we simulated my program and tested it out in manual, and finally, my program was working correctly. The other problem that I had with my program was that I have been unable to create an automatic sequence in order for my program to run in auto mode. This is a problem because the only two modes I can run my simulation in now is manual mode and semi-automatic.

Write in the third person

Good range of sources

9. Citation List

Listing method for sources is incorrect, this is not Harvard

([https://ladderlogicworld.com/ladder-logic-](https://ladderlogicworld.com/ladder-logic-basics/#:~:text=Ladder%20diagrams%20are%20used%20to)

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[generation.html#:~:text=Ladder%20Diagram%20is%20a%20graphical,circuits%20of%20relay%20logic%20hardware](https://www.mathworks.com/help/plccoder/ladder-diagram-modelling-and-code-generation.html#:~:text=Ladder%20Diagram%20is%20a%20graphical,circuits%20of%20relay%20logic%20hardware).

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[programming/#:~:text=One%20of%20the%20clearest%20benefits,is%20tight%20on%20memory%20space](https://www.motioncontroltips.com/instruction-lists-ils-plc-programming/#:~:text=One%20of%20the%20clearest%20benefits,is%20tight%20on%20memory%20space).

10. Appendix

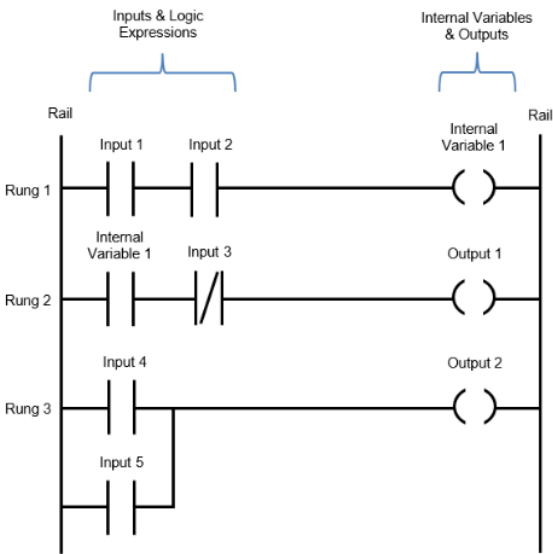


Figure 1 Ladder Diagram

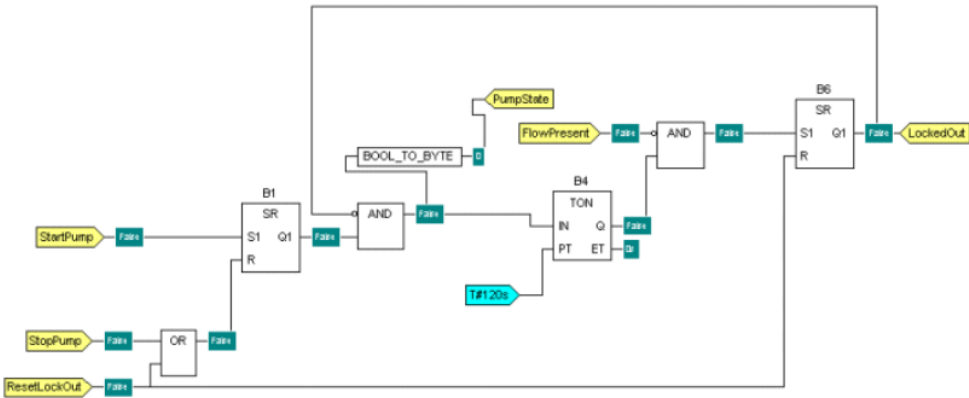


Figure 2 Function Block Diagram

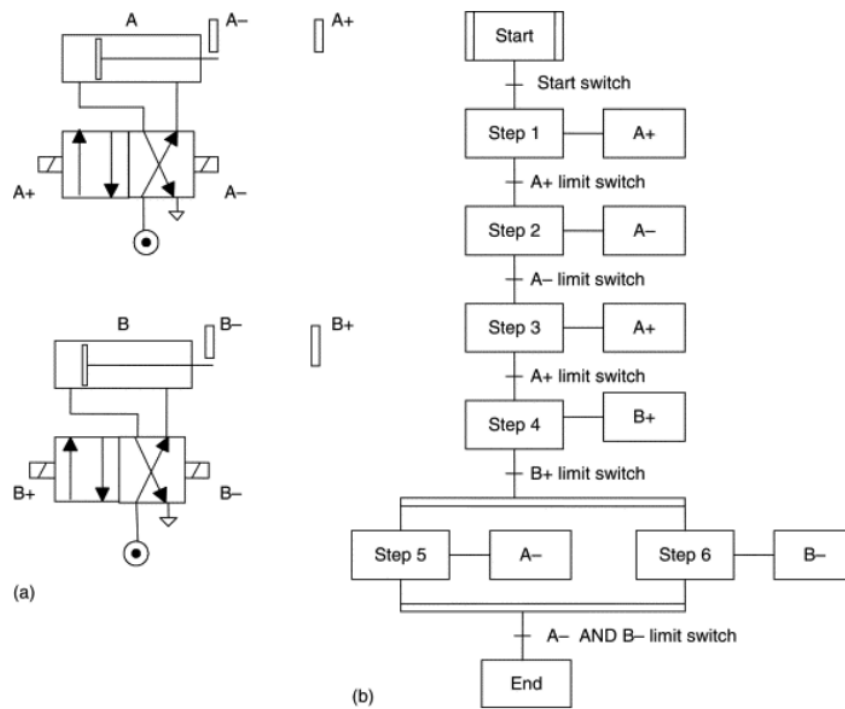


Figure 3 Sequential Function Chart

```

FindGreaterThan
1  FUNCTION FindGreaterThan : INT
2  VAR_INPUT
3    Threshold : REAL;
4  END_VAR
5  VAR_IN_OUT
6    Values : ARRAY[1..1000] OF REAL;
7  END_VAR
8  VAR
9    Found : BOOL;
10   Index : INT;
11 END_VAR
12
13 Found := FALSE;
14 Index := 1;
15 WHILE NOT(Found) AND Index <= 1000 DO
16   IF Values[Index] > Threshold THEN
17     Found := TRUE;
18   ELSE
19     Index := Index + 1;
20   END_IF;
21 END_WHILE;
22 IF Found THEN
23   FindGreaterThan := Index;
24 ELSE
25   FindGreaterThan := 0;
26 END_IF;

```

Figure 4 Structured Text

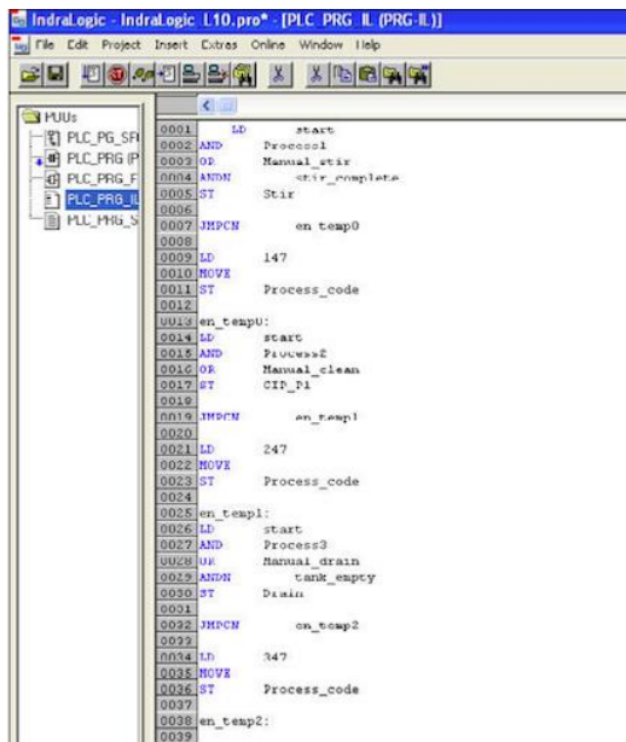


Figure 5 Instruction List

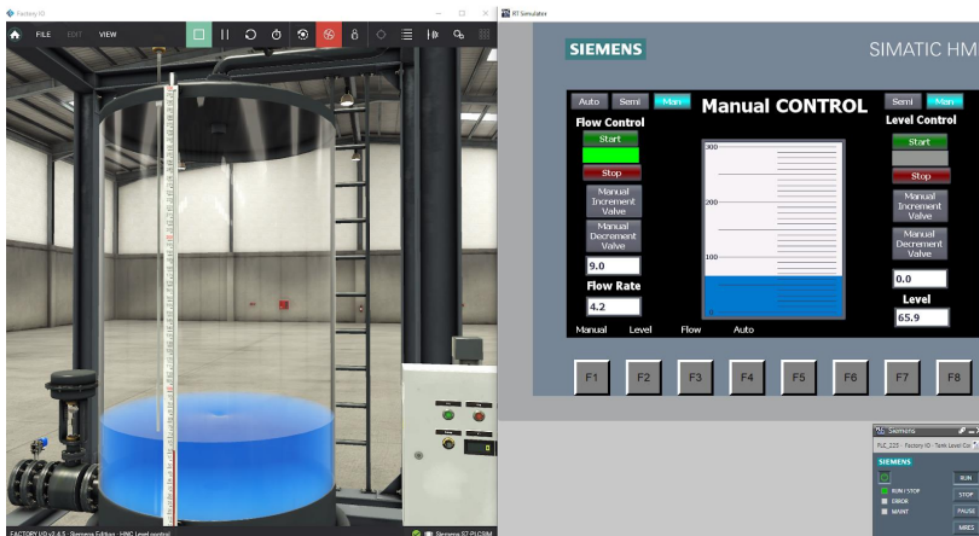


Figure 6

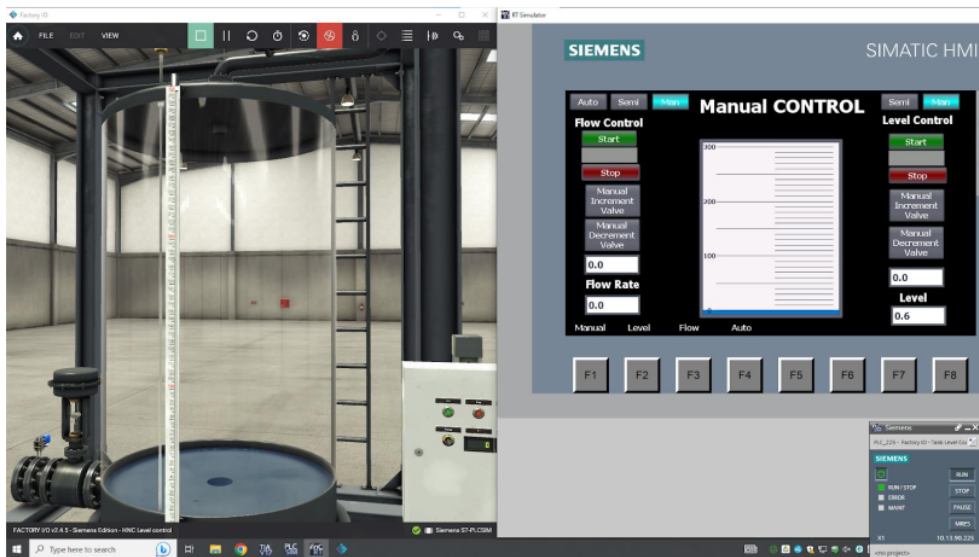


Figure 7



Figure 8



Figure 9

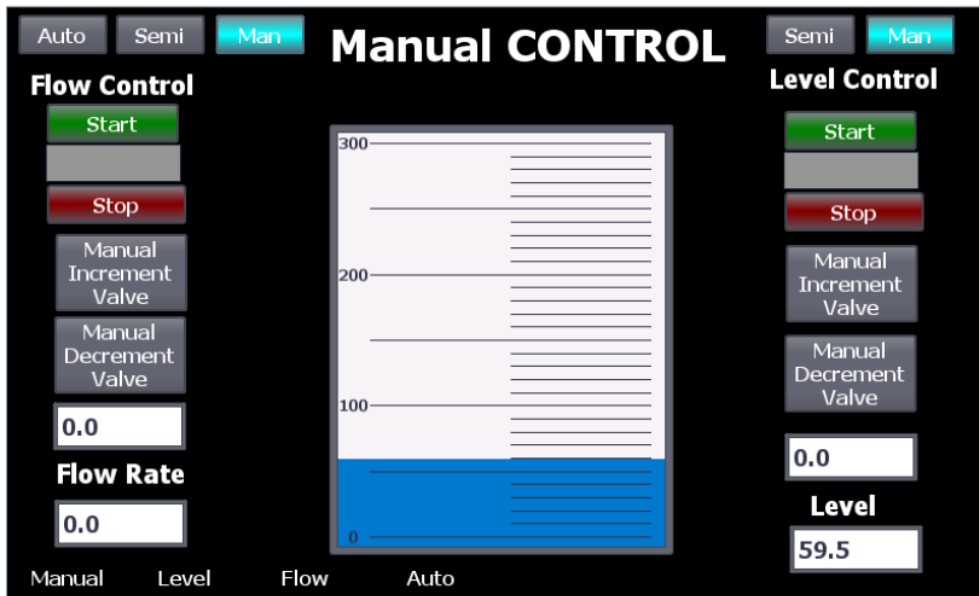


Figure 10

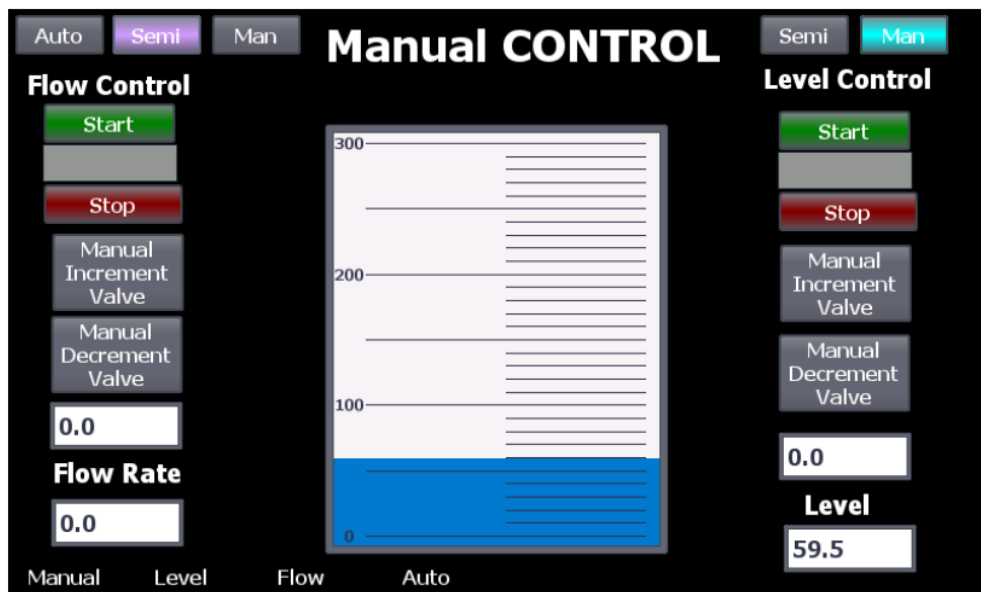


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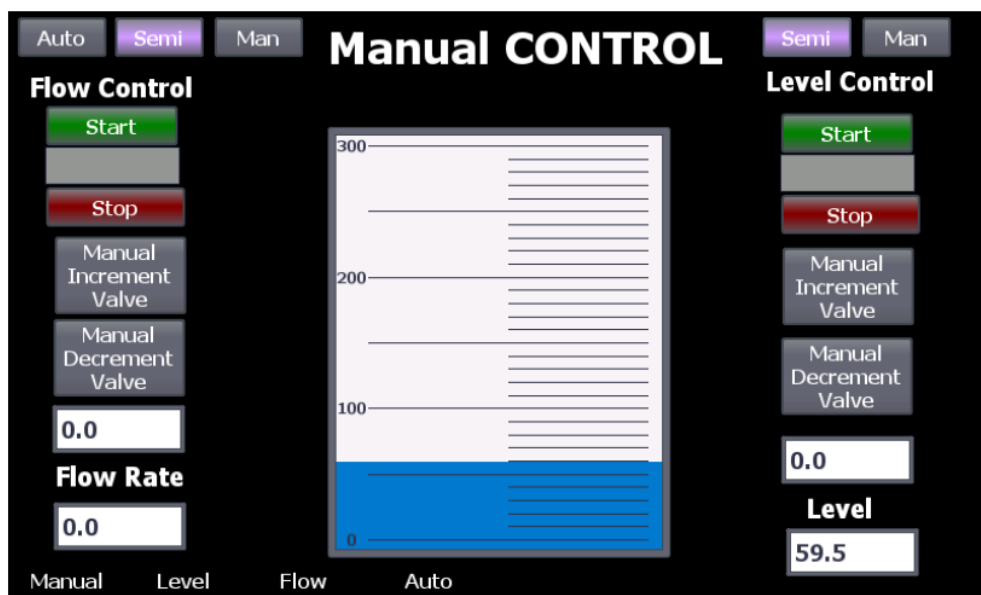


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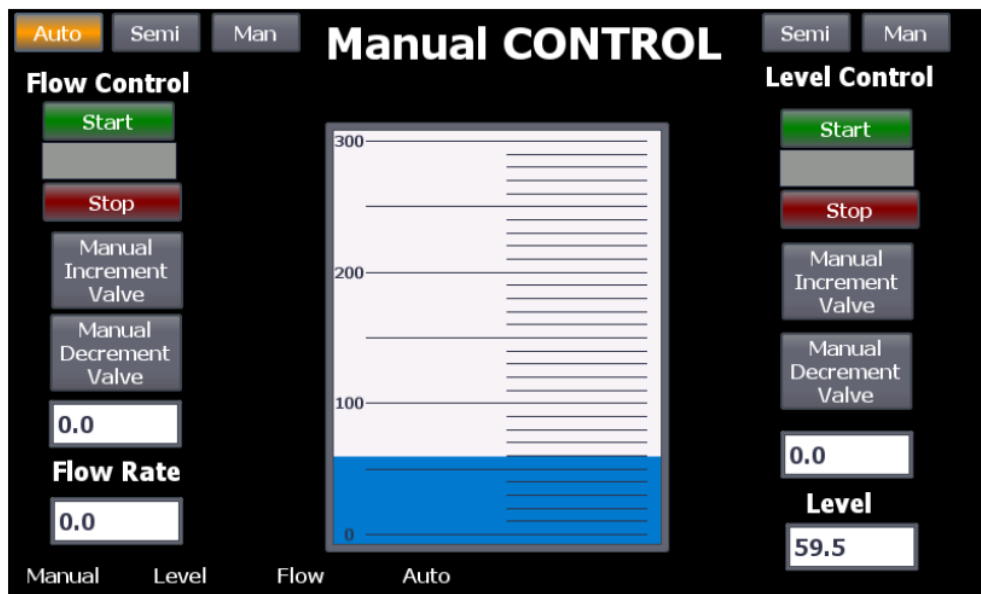


Figure 13



Figure 14



Figure 15



Figure 16



Figure 17

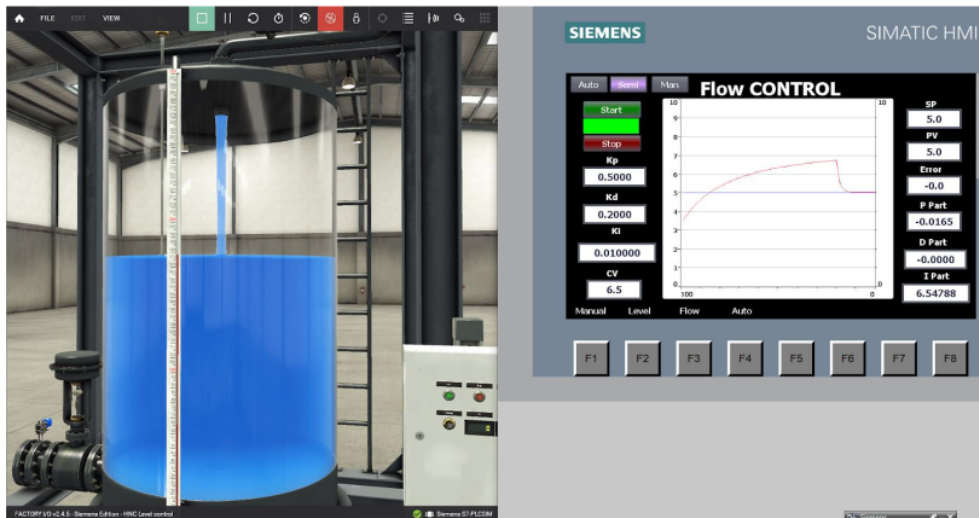


Figure 18

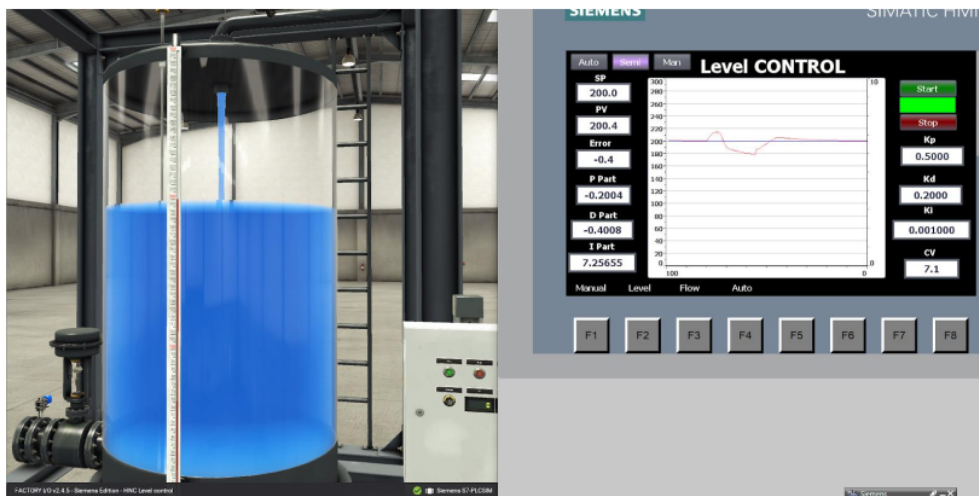


Figure 19

Instructor

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PAGE 1

QM

Page Numbering missing - switch on and place at bottom centre of page

When you create a document, switching on page numbering is the first thing you should do, forgetting this is a basic error that makes your table of contents meaningless

PAGE 2

QM

Good Structure

Report is structured exactly as stated in the assignment brief.

QM

Page Numbering missing - switch on and place at bottom centre of page

When you create a document, switching on page numbering is the first thing you should do, forgetting this is a basic error that makes your table of contents meaningless

PAGE 3**Text Comment.** This belongs as part of the citation list at the back

PAGE 4**Text Comment.** A good work plan

PAGE 5

QM

Write in the third person

Don't refer to your self as I, me, my or others as you etc. Avoid personal references. If absolutely necessary, refer to self as "the author".

Text Comment. the

Text Comment. Your descriptions above should have made reference to the figures in the appendix

Text Comment. You haven't chosen a language

PAGE 6

QM

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PAGE 7

Text Comment. Describe what you have produced, don't tell a story.

PAGE 8

Text Comment. An excellent table

PAGE 9

PAGE 10

PAGE 11

PAGE 12

Text Comment. Don't instruct your reader

QM

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Text Comment. What were the customer needs, how do you know you have met them?

PAGE 13

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PAGE 14

QM

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PAGE 15

QM

Good range of sources

You have demonstrated reading from a good range of sources shown by your list below

QM

Listing method for sources is incorrect, this is not Harvard

MS Word can automatically generate this list for you

PAGE 16

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ELLIS DICKESON

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1. ENGAGEMENT WITH LITERATURE

-  A good research section with some evidence of reading from a good range of sources cited but not listed correctly using the Harvard method. 10/20 **10**

2. KNOWLEDGE AND UNDERSTANDING

-  Some knowledge and understanding demonstrated in your hardware design, IO list and program design and explanations. However, no ladder included in report so no comments can be viewed. 10/20 **10**

3. COGNITIVE AND INTELLECTUAL

-  Good testing table with evidence and conclusions/recommendations. 12/20 **12**

4. PRACTICAL APPLICATION

-  Good screen designs but no program to view. 6/20 **6**

5. TRANSFERABLE SKILLS

-  Good workplan, structure, correct report format for font etc and word count. However, you must **10**

learn to write in the third person and you have not
numbered your pages. 10/20