

LEVEL 4 ASSESSMENT SPECIFICATION

Student name:	Chelsi Mason	Student ID number:	
Programme:	HNC Electrical/Electronic Engineering		
Module:	Programmable Logic Controllers		
Module code:	PCEE4005	Contribution to Overall Module Assessment (%):	50%
Lecturer:	Jason Pointer	Internal Verifier:	Lance Rutherford
Assignment Title:	PLC Program design and simulation	Word count (or equivalent):	2000
Submission deadline:	14/05/20	Return date of provisional marks & written feedback:	28/05/20
Submission method:	All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students' submissions.) Alternative submission method (if applicable): Late submission of the assessment will result in a late penalty mark. Penalties for late submission: Up to one week late, maximum mark of 40%. Over one week late, 0%. Only the Extenuating Circumstances Panel may approve a change to submission dates.		
Academic honesty / referencing:	Academic honesty is required. In the main body of your submission you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted in order to complete this assessment.		

Module Learning Outcomes (from module syllabus)

1. Demonstrate an understanding of the concepts of process control using an industry standard PLC.
2. Undertake basic PLC system design and implementation processes, comparing theoretical expectations to actual outputs ensuring correct operation and consideration of maintenance and reliability.

STUDENT FEEDBACK FORM

This section details the *extent* to which the assessment criteria are demonstrated by you, which in turn determines your mark. The marks available for each category of skill are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills	15	4.5
Poor engagement with essential reading. No evidence of wider reading. Reliance on inappropriate sources.		
2. Knowledge and Understanding Skills	25	9.7
Task 1 achieved 35%. Task 2 achieved 50%. Gaps in knowledge of the basic underlying concepts and principles of input and output devices. There was a lack of detail in the explanations require for Task 1 and in some parts a lack of understanding. Task 2 showed a good understanding linking the use of SCADA to location industry.		
3. Cognitive and Intellectual Skills	15	4.5
Superficial evaluation of the underlying concepts and principles applied to the construction of the programs for Task 3 and 4.		
4. Practical Application Skills	35	22.8
Task 3 achieved 80%. Task 4 achieved 50%. A good application of the different software to produce nearly fully functional programs to cover the requirements of Task 3 and 4. Task 3 was completed classroom sessions but did require some support with construction of the function blocks. Task 4 and did not achieve all set specifications, have only produced ladder logic to operate one of the tanks.		
5. Transferable Skills for Life and Professional Practice	10	5
Mostly ordered presentation and structure but in places does lack some coherence.		

Assessment Mark (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.)	Late Submission Penalties (tick if appropriate)		47%
	Up to 1 week late (40% Max)		
	Over 1 week late (0%)		

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Programmable Logic Controllers

Assignment 2



Student: Chelsi Mason
Student Number: 141560
Lecturer: Jason Pointer

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Introduction

The first task in this report will discuss PLC inputs and outputs explain examples of both kinds of devices. These will be both analogue and discrete. This will be discussed in four parts; input devices; analogue to digital conversion, output devices and output switching of relay and transistor types.

The second task will discuss the SCADA system explaining the key features. It will explain how PLC's and interfaces are connected and integrated and also explain examples of SCADA systems using in engineering environments.

The third task will be of a PLC programme for a Process Alarm Panel and a sketch of the Human Machine Interface. For this task Mitsubishi Alpha will be used to build both the programme and the Process Alarm Panel.

The fourth task will use the Do More Designer programme to design a PLC system for a tank filling system. The system will be built using ladder logic and following the correct timings, inputs and outputs. The system will then be simulated to be tested to make sure it works correctly and to fault find any issues. This system will be attached to the report. I will then evaluate and conclude on the system commenting on any issues and or improvements that could be made.

Task 1 – PLC analogue and discrete I/O

A. PLC input devices detect and measure specific variables. One example is a temperature sensor. These sensors can be RTD's (resistive temperature devices) or thermocouples. They will measure the temperature in the area and when the temperature reaches or drops below a specific set point the input will output signal throughout the PLC's making the circuit.

Mechanical switch is another example of an input device. These rely on an outside source to physically move the switch to either the open or closed position. These switches are wired as Normally Open (NO) or Normally closed (NC) depending on the type of circuit and output they are within. A NO switch will close the circuit when it is moved the circuit is powered throughout.

Another example of an input device is a proximity switch. These switches work by only detecting the presence of the object in the area surrounding the switch without contacting it. When the object is met the PLC circuit will be closed and activate.

A fourth example of an input device is a liquid level sensor. These level switches will be in for example a chamber/tank containing liquid. When the liquid reaches or drop below the switch the switch will send the signal to the PLC and the output will work to control the level in the chamber.

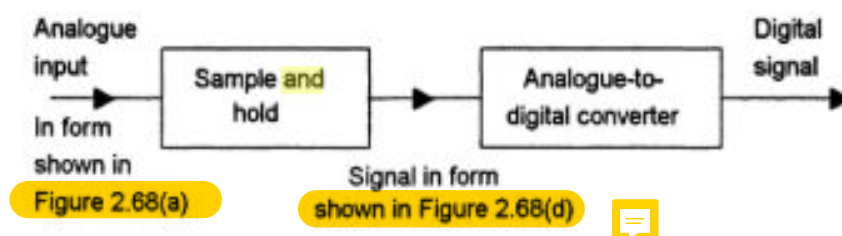


Figure 1.0 above illustrates 4 proximity switches as described in Task 1 A.

B. Analogue to Digital Conversion

W. Bolton says 'Analogue to digital conversion involves a number of stages'.

W. Bolton uses the below diagram to illustrate the process of ADC.



In Binary there are two digits, 1 being the 'high' or 'on' signal and 0 being the 'low' or 'off' signal. When grouped together these bits create a word. When converting analogue to digital binary is used to represent the analogue signal. This is because digital is either an on or off signal the same as the binary digits. Three binary numbers make up the word for example 000 = 0, 001=1, 011= 3. With 3 bits in the word there 8 possible outcomes. These equal to 0-256 outcomes/values. The analogue inputs which create the digital outputs are called quantization levels.

C. PLC Output Devices

One example of an output device is an alarm. These will sound when the input has measured a certain level/temperature etc. When it does the PLC sends the signal to the output to sound.

A second example is an indicating light. These will illuminate when the signalled to by the PLC due to the state of the input device. For example when an operation has started or a desired level is reached.

A third example is a solenoid. These are desirable over as they have more power than electrical outputs and can perform the output task over and over again. Solenoids work by creating a magnetic field which pulls the plunger down and venting the air to move whatever they are connected to.

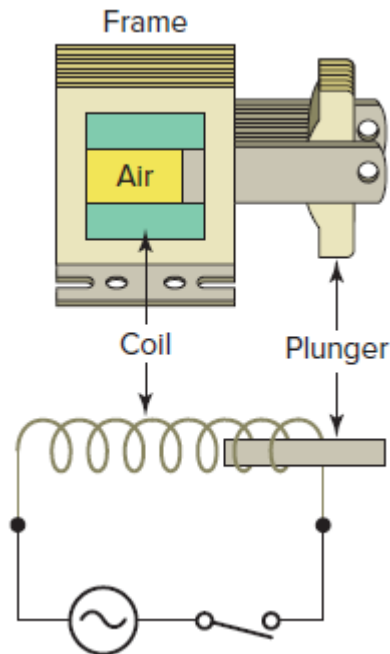


Figure 1.1 illustrated the components of a solenoid.

A fourth example of an output device is a motor. When activated these motors will drive whatever device they are connected to. For example the motor for a fan to cool the product to a desired value.



D. PLC relays and transistors

The main difference between relay and transistor outputs is the power they can switch. Transistors are used to output small loads of up to 24 volts and relays can switch larger loads by incorporating magnetic fields and multiple circuits. The transistor works when the PLC supplies the current closing the transistor output which closes the circuit so it is powered throughout.

The main benefit of relays is that they can switch both AC and DC signals. However due to switching larger loads relays are slower than the transistor and has shorter lifetime. Transistors are quick and seem to last a lot longer leaving longer time between replacements.



Task 2 – SCADA (Supervisory Control and Data Acquisition)

SCADA is a computerized system used to gather and analyse data from a process. They can monitor the condition of the process and also control it by using PLC's. The SCADA system can analyse small processes and plants i.e. an office/workspace or a large more complex plant i.e. oil refinery with multiple processes going on at once. SCADA systems work to help operators and employees make important decisions and help to reduce process and instrument downtime. The key feature of a SCADA system is that it has the ability to perform an action through a computerised system and send it to the device. It takes away the operator having to go to the field to view the process and monitor it.

An example of a SCADA system which is used on the Pembroke Valero Refinery is Delta V. this system monitors the entire plant and is split between 3 control rooms. In each control room there are multiple control panels with HMI's for each process unit. Human Machine Interfaces (HMI's) are used to optimise the industrial process. For example the Cracking and Olefins control room has 3 control panels with HMI's. The panel consists of multiple computer screens of HMI's so that the operator can control the equipment when it is in manual control and monitor it throughout the day. PLC's control a lot of the equipment on the plant and send output signals to the panels indicating alarms to the operator so that they can take the necessary action to control the plant.

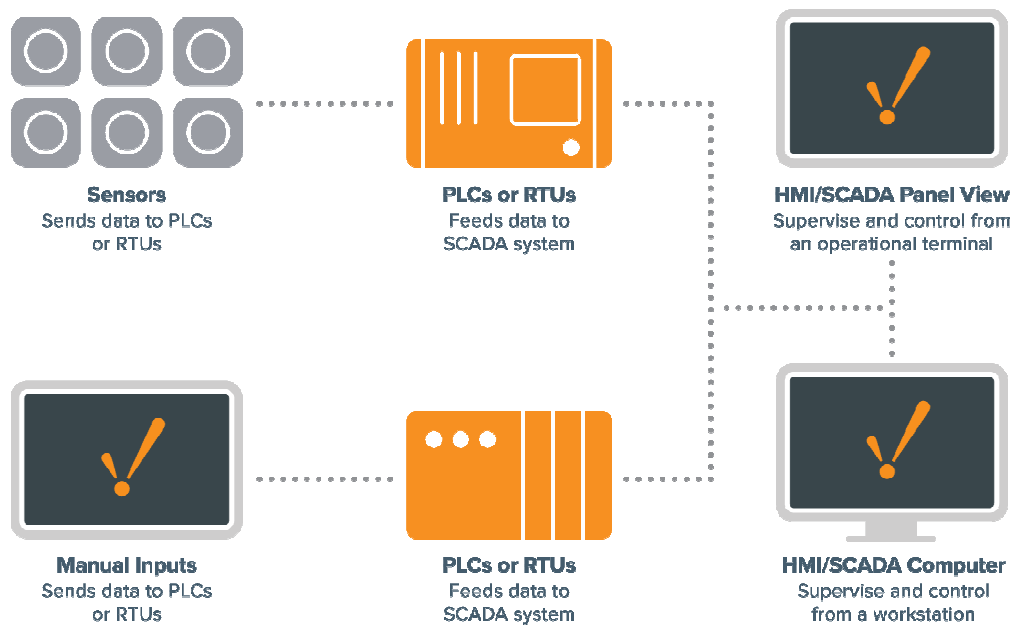
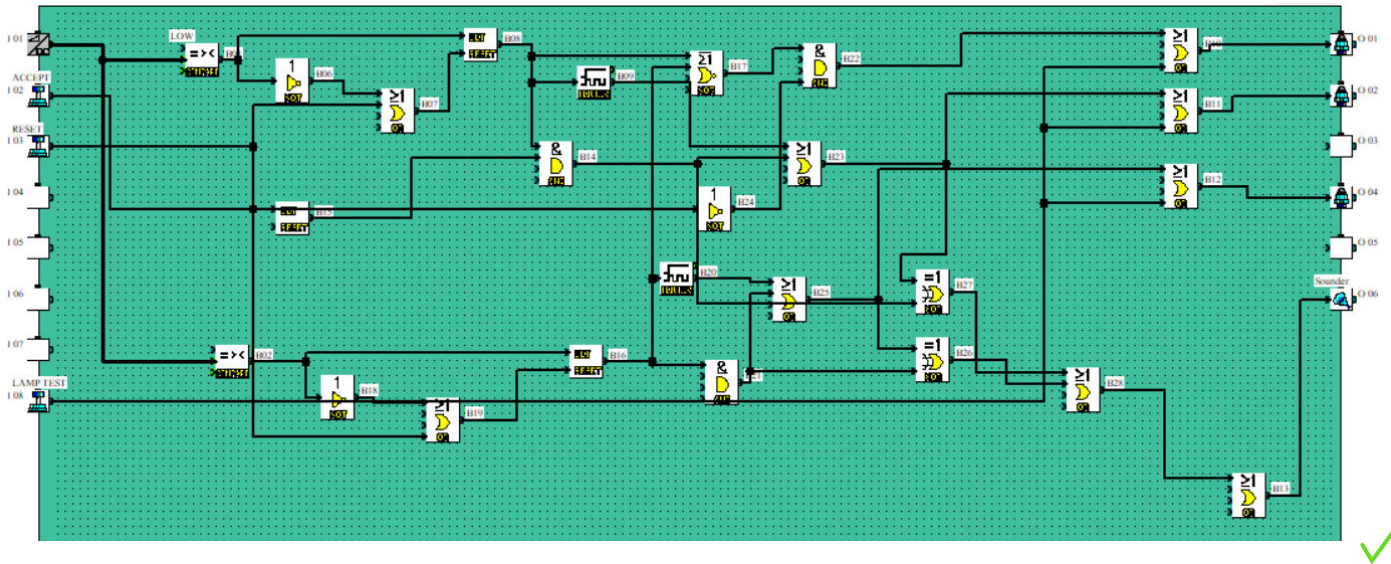


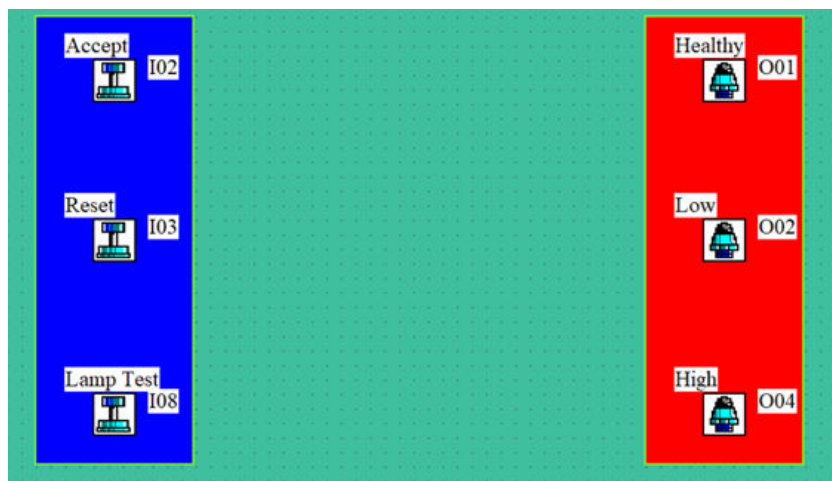
Figure 1.2 illustrates a basic SCADA system with the main components and features.

Task 3 Process Alarm Panel

For this task I used the Mitsubishi Alpha programme to design, test and simulate the required process alarm panel. This is attached in the report file. The programme was constructed using logic gates, delays, switches and other functions. The required inputs and outputs were used and tested all alarms and lights to make sure all aspects of the programme worked correctly. I first set out the inputs on the left of the screen and then assigned the correct outputs. For each alarm there was an indicator light. All three were different colours so that they were easy to distinguish. The colours were green, amber and red. When the inputs and outputs were assigned I then went ahead and set out the set-resets. Next came the logic gates, timers and counters. Once this was finished the last step was to add in the lamp test.

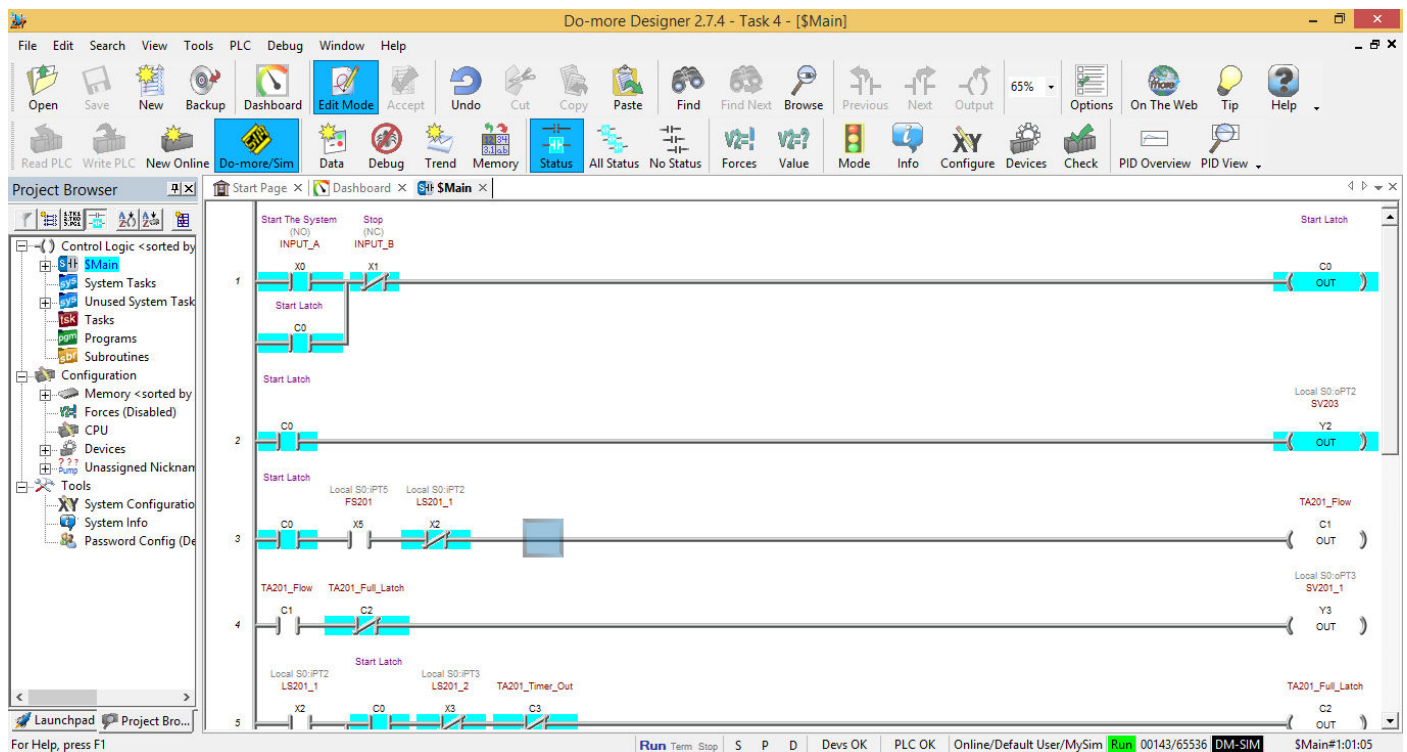


Once this was completed I went ahead and tested the simulation. When it I then used the sketch window in the Mitsubishi programme to design the HMI panel to show the indicators for the inputs and outputs. This is shown in the image below.



Task 4 – Programming Problems

For this task I chose to use the Do More Designer to build the ladder logic to control the process. The programme already had the ladders set out on its display page so I just went ahead and added the correct inputs and outputs. I made sure my programme followed the sequence the task set out. I used latches, on-delays and other logic functions to create the system. I tested the system at each stage to make sure it was built and working correctly. This made it easier to fault find. I was able to assign the correct addresses to the inputs and outputs so that the contacts closes and or opens at the correct timings. Below are screenshots of the programme designed and then simulated. I have also included screenshots of the timers which count down and up before moving onto the next stage as requested in the task description.



Do-more Designer 2.7.4 - Task 4 - [\$Main]

File Edit Search View Tools PLC Debug Window Help

Open Save New Backup Dashboard Edit Mode Accept Undo Cut Copy Paste Find Find Next Browse Previous Next Output 65% Options On The Web Tip Help

Read PLC Write PLC New Online Do-more/Sim Data Debug Trend Memory Status All Status No Status Forces Value Mode Info Configure Devices Check PID Overview PID View

Project Browser

- Control Logic <sorted by>
 - \$Main
 - System Tasks
 - Unused System Task
 - Tasks
 - Programs
 - Subroutines
- Configuration
 - Memory <sorted by>
 - Forces (Disabled)
 - CPU
 - Devices
 - Unassigned Nicknames
 - Tools
 - System Configuration
 - System Info
 - Password Config (De

Launchpad Project Bro...

For Help, press F1

Run Term Stop S P D Devs OK PLC OK Online/Default User/MvSim Run 00143/65536 DM-SIM \$Main#5:01:05

Do-more Designer 2.7.4 - Task 4 - [\$Main]

File Edit Search View Tools PLC Debug Window Help

Open Save New Backup Do-more Simulator

File Sim

DM/SIM 16 DI 16 DO 8 Analog Inputs 8 Analog Outputs

DM v2.7.0 Sim v2.7.4

PA/R SerR/L RUN SerTX ROM ErrR ERR ErrTX

RUN TERM STOP

C Memory C0 C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 C20 C21 C22 C23

Counters

CT0 Acc	0	Done
CT1 Acc	0	Done
CT2 Acc	0	Done

V Memory

V0	0
V1	0
V2	0
V3	0
V4	0
V5	0
V6	0
V7	0

D Memory

D0	0
D1	0
D2	0
D3	0
D4	0
D5	0
D6	0
D7	0

R Memory

R0	0.000
R1	0.000
R2	0.000
R3	0.000
R4	0.000
R5	0.000
R6	0.000
R7	0.000

Strings

MSG	
ERR	
SS0	
SS1	
SS2	
SS3	
SL0	

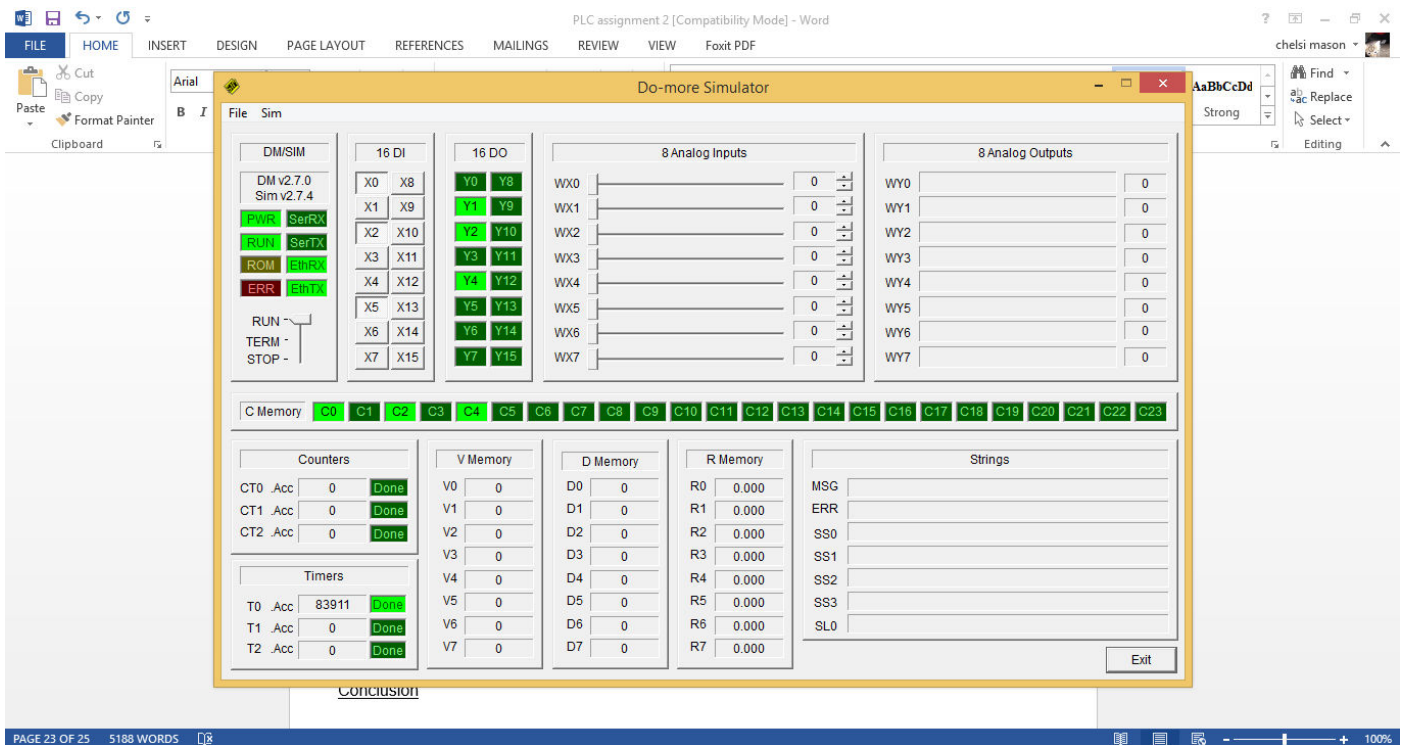
Exit

6

For Help, press F1

Run Term Stop S P D Devs OK PLC OK Online/Default User/MySim Run 00143/65536 DM-SIM





Evaluation

Overall I think my programme worked **correctly and efficiently**. It followed the correct sequence so when applied to the process it would control the instruments, valves and pumps correctly. The Do More Designer is user friendly programme. It is simple to navigate and I found creating the circuit to be easier than other programmes I have used. I think an improvement would be to label each step within the programme so that it is easier to see what is happening. I also think adding spares would make it more efficient in the real world. This would allow technicians to reduce downtime as they would be able to use the spare inputs when others become unusable or damaged.

Conclusion

In conclusion the programme worked the way it was meant to. It followed the correct sequence and worked to correct timings with all the necessary inputs and outputs. The programme is user friendly and easy to follow to see what is happening at each point in the system.

References and Bibliography

Front cover image

https://www.google.com/search?q=operator+panel&sxsrf=ALeKk00PzI2ftPG9cFPxc-EvkYtMFUxQsA:1589458316422&source=lnms&tbm=isch&sa=X&ved=2ahUKEwj9fSqbpAhW0qHEKHZLMBdoQ_AUoAXoECAwQAw&biw=1366&bih=625#imgsrc=Wj-fbWvbL_qAcM
(25/04/20)

Figure 1.0

https://www.google.com/search?q=proximity+switch&sxsrf=ALeKk01z2tgNqcFSCcF5au4wrCgl3K-GJQ:1589458057270&source=lnms&tbm=isch&sa=X&ved=2ahUKEwj63o3XqLPpAhVvTxUIHXLDCjYQ_AUoAXoECA0QAw&biw=1366&bih=625#imgcr=ZE5OBFfuvNvAfM (25/04/20)

<https://www.slideshare.net/ArkoSaha1/input-output-devices-for-plc>(25/04/20)

[https://www.google.com/search?bih=625&biw=1366&hl=en-GB&sxsrf=ALeKk01EDOODctt7SKKVrgOkUeLZZOQLJg%3A1589457200684&ei=MDG9XseqKbSM1fAP7Pq0OA&q=plc+inputs&oq=plc+inputs&gs_lcp=CgZwc3ktYWIQAziHCCMQsQIQJzIHCAAQFBCHAjICCAAyBwgAEBQQhwlyBAgAEAoyBAgAEAoyBAgAEAoyBAgAEAoyBAgAEAoyBAgAEAo6BAgjECc6BAgAEEM6BQgAEJECoGolABCDARAUElcCUIUFWNoRYK4UaABwAHgBgAGAA4gBiw6SAQcxLjMuNC4xmAEAoAEBggEHZ3dzLXdpeg&sclient=psy-ab&ved=0ahUKEwjHgtS-pbPpAhU0RhUIHWw9DQCQ4dUDCAw&uact=5\(25/04/20\)](https://www.google.com/search?bih=625&biw=1366&hl=en-GB&sxsrf=ALeKk01EDOODctt7SKKVrgOkUeLZZOQLJg%3A1589457200684&ei=MDG9XseqKbSM1fAP7Pq0OA&q=plc+inputs&oq=plc+inputs&gs_lcp=CgZwc3ktYWIQAziHCCMQsQIQJzIHCAAQFBCHAjICCAAyBwgAEBQQhwlyBAgAEAoyBAgAEAoyBAgAEAoyBAgAEAoyBAgAEAoyBAgAEAoyBAgAEAo6BAgjECc6BAgAEEM6BQgAEJECoGolABCDARAUElcCUIUFWNoRYK4UaABwAHgBgAGAA4gBiw6SAQcxLjMuNC4xmAEAoAEBggEHZ3dzLXdpeg&sclient=psy-ab&ved=0ahUKEwjHgtS-pbPpAhU0RhUIHWw9DQCQ4dUDCAw&uact=5(25/04/20))

W.Bolton, Instrumentation and Control Systems, 2004, Second Edition 2006 Linacre House, Jordan Hill, Oxford, Pages 45-47.

Figure 1.1

<https://basicplc.com/plc-actuators-and-output-devices/>(25/04/20)

<https://support.industry.siemens.com/tf/ww/en/posts/transistor-outputs-relay-outputs-difference/84385?page=0&pageSize=10>(25/04/20)

<http://www.plcmanual.com/plc-output-units>(25/04/20)

<https://www.webopedia.com/TERM/S/SCADA.html> (27/04/20)

<https://en.wikipedia.org/wiki/SCADA> (27/04/20)

Figure 1.2

<https://inductiveautomation.com/resources/article/what-is-scada> (01/05/20)