

2018156

by Jonathan Davies

FILE	16749_JONATHAN_DAVIES_2018156_178848_116867143.PDF (1.1M)		
TIME SUBMITTED	08-FEB-2021 11:54PM (UTC+0000)	WORD COUNT	1856
SUBMISSION ID	144450809	CHARACTER COUNT	8743

Course: HNC Electrical and Electronic Engineering

Module: SGEE4004 Programmable Logic Controllers

Assignment: 1. Pick and Place Robot

Name: Jonathan Daffydd Lee Davies University number: 2018156

Date submitted: 08/02/2021

Word count: 1734

1. Research

The purpose of the assignment is to create a PLC system design sequence that can control a pick and place robot. The pick and place robot are located within the college and the IEC programming languages are used within the program design. Also featured are the input and output device listing, program design and testing. All the design processes, including testing and evaluation, are documented within the assignment. As well as individual work there will be a small group task where demonstration of the system in working condition.

The programmable logic computer (PLC) is used within industry for several different types of applications and functions. Siemens have a range of PLC's available for different demands, in order to pick the correct PLC to perform the desired function, in this case a pick and place robot, research into the PLC types, cost implications and technical data must be completed in order to determine the appropriate PLC. There are 3 types of PLC's which are unitary, modular and rack mounted and are compatible with Siemens TIA portal, the programmable software used to set parameters. (Siemens, 2021)

An example of a Siemens unitary PLC is the S7-1211C, which has compact CPU and is none expandable and has a set number of inputs and outputs helping to keep the PLC at a low cost. Siemens modular DIN rail PLC's are the S7-1212C, S7-1214, S7-1215 which offer greater expandability depending on demand. The rack mounted PLC's such as the S7-1500 series, have the greater cost but in return produce a higher power as well as a great amount of expandability for more demanding and complex functions. (Siemens, 2021)

The 1500 is a modular PLC

PLC Series	Type	Cost	I/O	mS per 1K instruction	Memory
S7-1211C	Unitary	£182	8/4	0.08	50KB
S7-1212C	Modular	£244	10/6	0.08	75KB
S7-1214C	Modular	£369	16/10	0.08	100KB
S7-1215C	Modular	£556	16/10	0.08	125KB
S7-1500	Rack	£2,152.00 - £9,476.00	37/34	0.05	1250KB

(Siemens, 2021)

From the various PLCs available series, the 1214C is the best option due to the available memory and the number of available I/O. With a medium cost compared to other PLCs in the series but provides the best value for money with the ability to be expanded and keep up with the demand of the functions due to being designed for automation functions. (Siemens, 2021)

A good conclusion

A good I/O list but the inputs should have the I addresses listed here not their M addresses which are only for simulation and are mapped to Ms when in non-simulation mode.

2. Hardware Investigation, Circuit Diagram and I/O List

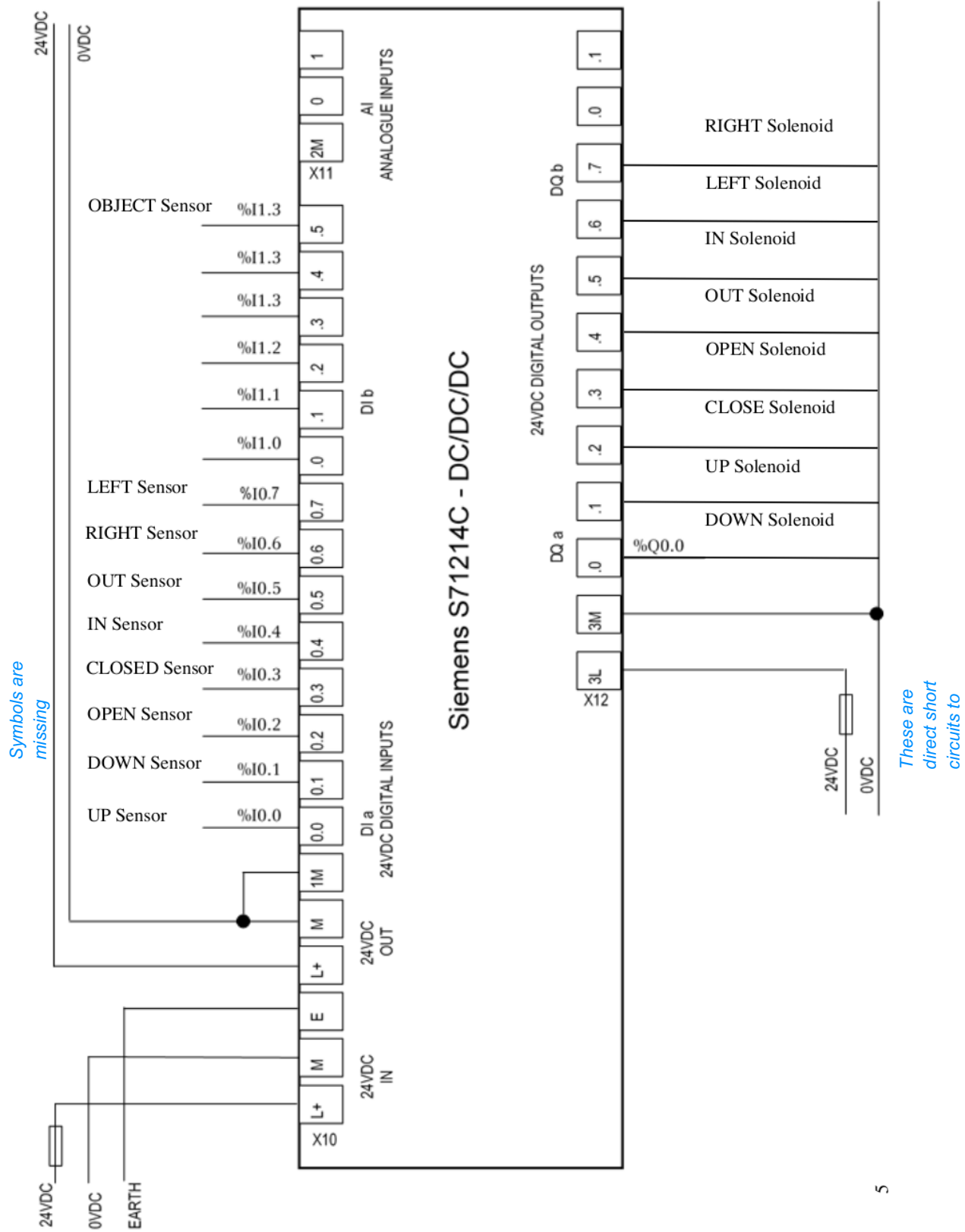
Inputs	Address
UP sensor	%M0.0
DOWN sensor	%M0.1
OPEN sensor	%M0.2
Closed sensor	%M0.3
IN sensor	%M0.4
OUT sensor	%M0.5
RIGHT sensor	%M0.6
LEFT sensor	%M0.7
OBJECT sensor	%M1.5

Outputs	Address
DOWN solenoid	%Q0.0
UP solenoid	%Q0.1
Gripper CLOSE solenoid	%Q0.2
Gripper OPEN solenoid	%Q0.3
Move OUT solenoid	%Q0.4
Move IN solenoid	%Q0.5
Move LEFT solenoid	%Q0.6
Move RIGHT solenoid	%Q0.7

Investigate the hardware used on the Pick and Place Robot and provide a complete explanation of each device used together with an electrical drawing of the PLC

This is from the brief - unnecessary to include it

Is this page intentionally left blank?

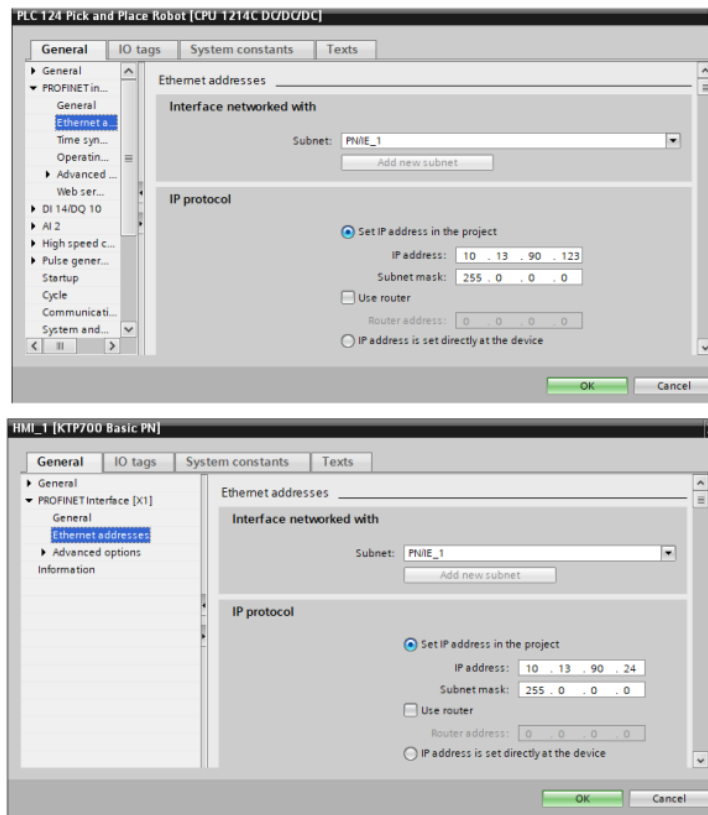


3. Program Design and Explanation

Manual controls *You don't need to explain how to create the program, focus instead on explaining how it works.*

After the hardware and I/O investigation and the circuit diagram of the planned program the next step is the design the program. The first task is to set up the PLC and HMI screen with suitable IP addresses for the system to be compiled and run without conflict. This would also allow the system to only run on the system network without interference.

The image below shows the PLC set up with a suitable IP address.



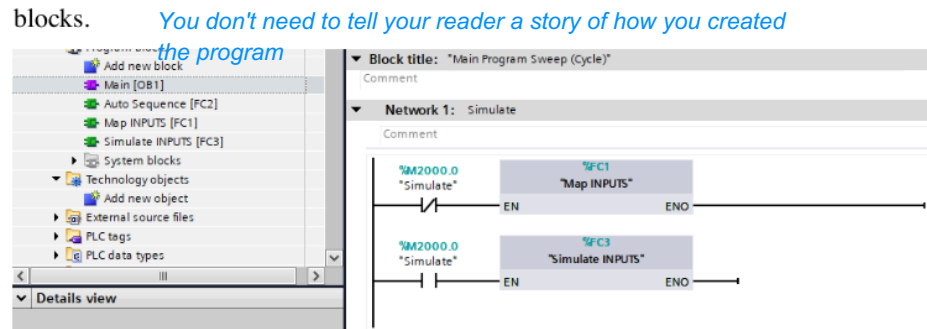
Above is the HMI screen set up with the IP address. The HMI and PLC are connected on the same network and are paired so that the commands of the PLC will display on the HMI when tagged.

A memory element is added to the tags to simulate for the actual inputs to have a simulation block is used to design the program without hardware. The memory starts from M2000.0 to avoid conflict when mapping the inputs into memory elements. The list of I/O from section 2 was placed within a tag table in the program and used as a starting point for basic functions. Additional tags were added as they were required during the program build including the Auto request for the operator and engineers' screens as well as Manual for the engineers screen.

Further to the tag lists being created the main data block was created for the commands for program instructions, interlocks and other functions would be added in order for the program to meet demand. This is shown in the image below.

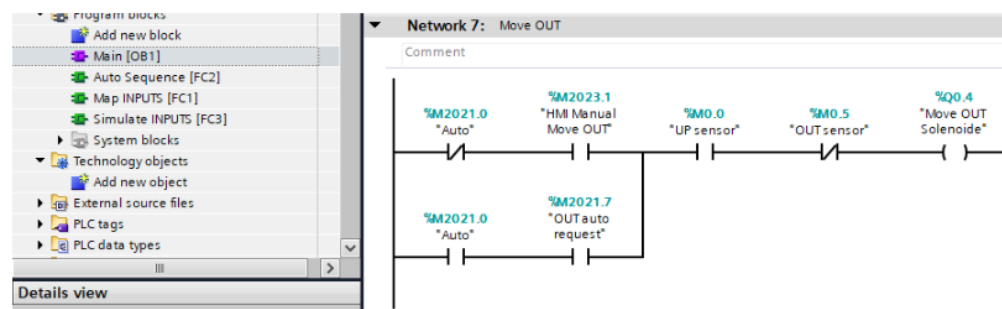


To create the first network, the Map inputs and Simulated inputs blocks were created using the LAD programming language then dropped into the network. This also allows the network to be automatically updated when changed in the function blocks. Below is the first network with the inserted function blocks.

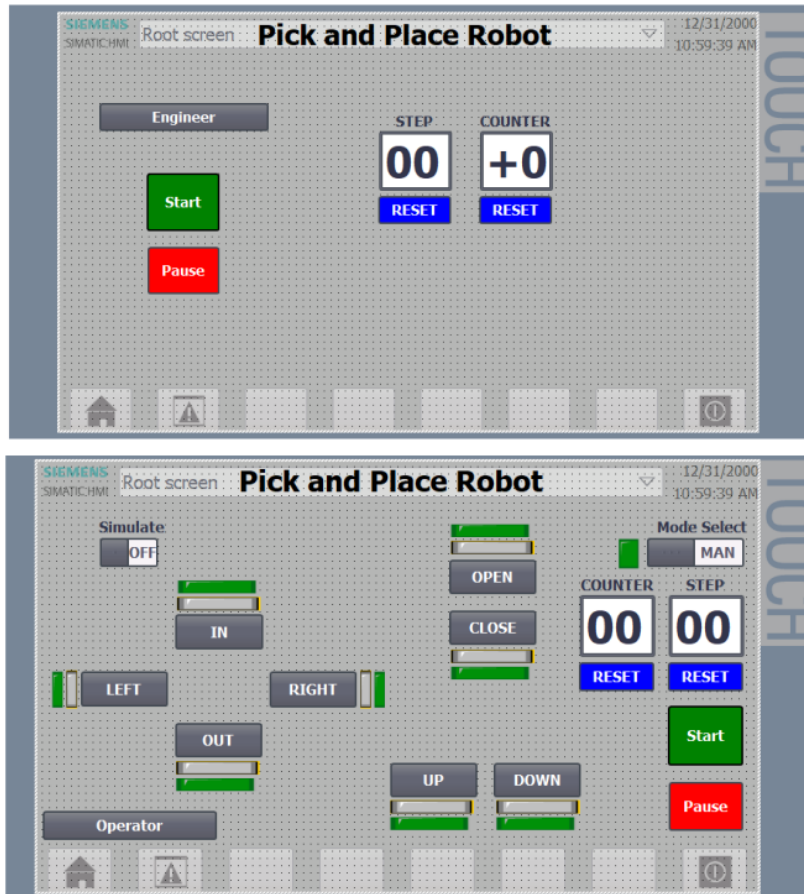


Network 3 was also created using the same method with the auto sequence function block that was written in the SCL programming language. These can be seen within the annexe.

In order to access the automatic mode of the program the functions parts of the network has been set up with a normally closed contact Auto which is in series with the HMI manual request, with the 2 being in parallel with a normally open contact Auto and Auto request contact the bottom contacts in series provide a bypass when the program is set to automatic and will not allow the program to be used in manual mode the same time. Below is an example of the automatic mode:

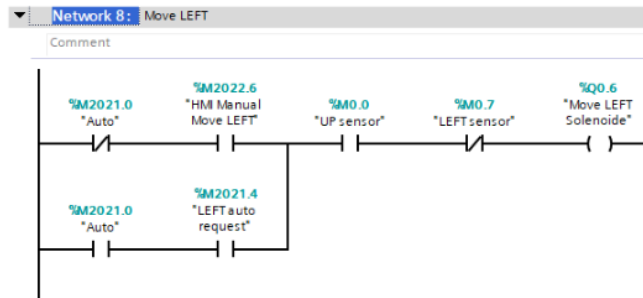


To control the robot with ease the HMI screens add a visual element to the program where the use of a push button activates the system with ease. There are 2 HMI screens created, one for the operator and one for the engineer. Below is the operator's screen.

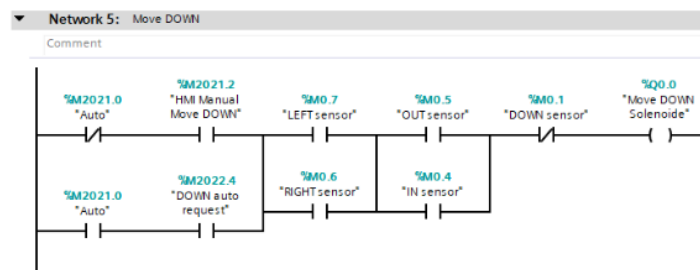


The image above shows the engineers screen which is much more detailed than the operators with visual indications when sensors and solenoids are active. Also while in manual mode the engineer can operate each piston individually.

When operating the program care is taken not to damage the hardware components to do this, interlocks were placed within the networks to limit movement when performing specific functions. For example, when moving left and right the arm of the robot needed to be up in the air so contact is not made with surrounding chutes or objects. In order to provide an interlock, the up sensor contact is placed within the network as below.



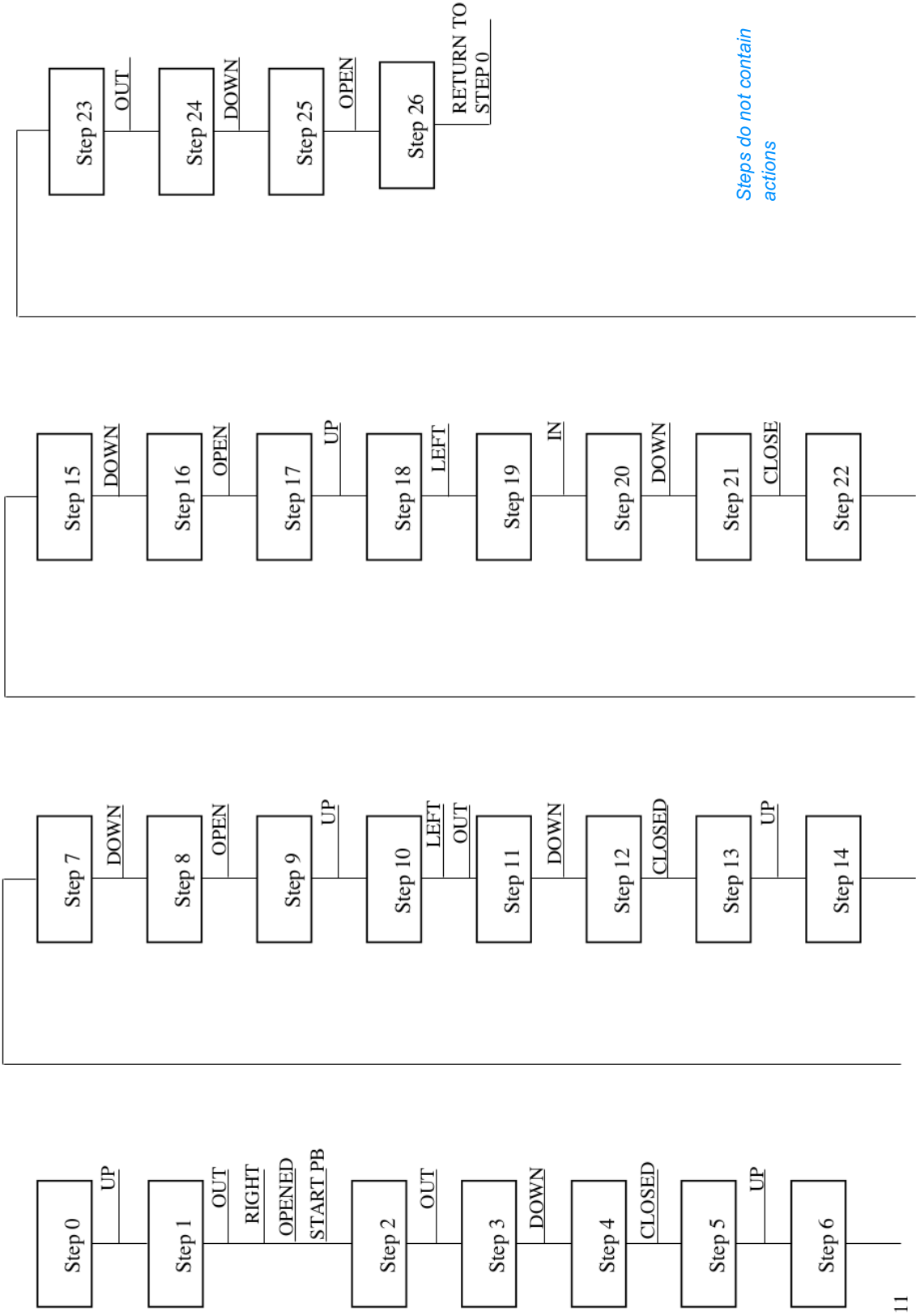
Other interlocks were added to the down network to ensure that the arm only came down at desired stations to further reduce any risk of collision. This is shown in the image below.



With the interlocks in place the robot cannot move left, right in or out unless it is in the up position and cannot move down unless over one of the stations. Further interlocks can be seen within the annexe.

When the system is set up into the automatic mode there needs to be a set of instructions that is followed. To determine the sequence a sequential function chart was created before the SCL block was created.

*You did
not
include
the Annex
!!*



IN

RIGHT

UP

From the sequential function chart the SCL instructions can be followed. Below is an example of step 0 and step 1 of the automatic sequence. The reminder of the 26 steps can be found in the annexe.

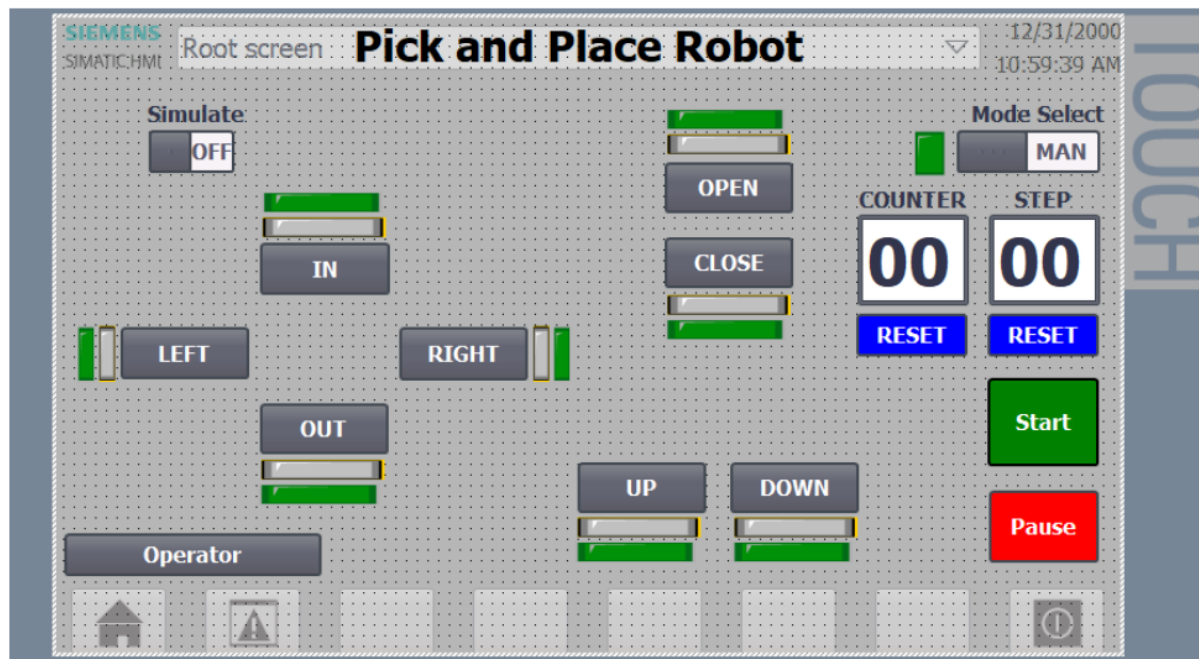
```

13      0:
14      "UP auto request" := 1;
15      IF "UP sensor" = 1 THEN
16          "UP auto request" := 0;
17          "Next_Step" := 1;
18      END_IF;
19      1: //Move Home
20      "IN auto request" := 1;
21      "RIGHT auto request" := 1;
22      "OPEN auto request" := 1;
23      IF ("IN sensor" = 1) AND
24          ("RIGHT sensor" = 1) AND
25          ("OPEN sensor" = 1) AND
26          ("START sequence" = 1) THEN
27          "RIGHT auto request" := 0;
28          "IN auto request" := 0;
29          "OPEN auto request" := 0;
30          IF ("Object Counter".CV = 1) THEN
31              "Next_Step" := 18;
32          END_IF;
33          IF ("Object Counter".CV = 2) THEN
34              "Next_Step" := 10;
35          END_IF;
36          IF ("Object Counter".CV = 3) THEN
37              "Next_Step" := 2;
38          END_IF;
39      END_IF;
40      2: //move object from station 3 to station 4

```

There is no Annex !!

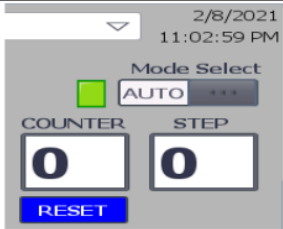
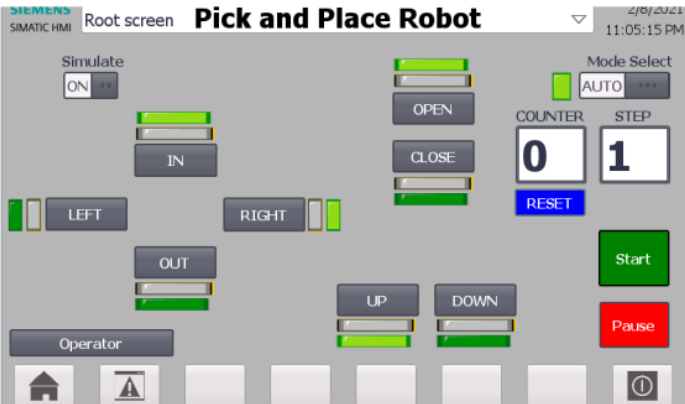
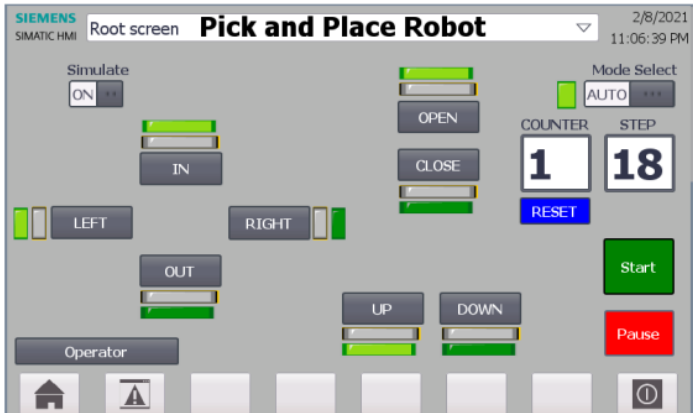
As previously mentioned, the engineers screen is much more detailed than the standard screen of the operator. The engineer has access to manual mode which can be controlled by pressing the buttons and testing the automated sequences by monitoring the lights as they activate during movement. Both screens feature a counter and step counter to monitor the robot at different stations.

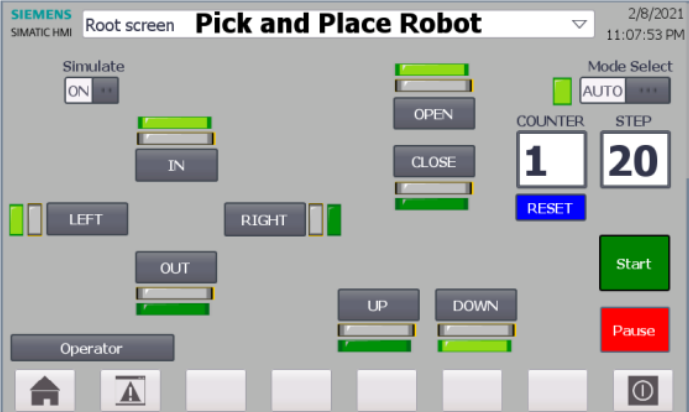
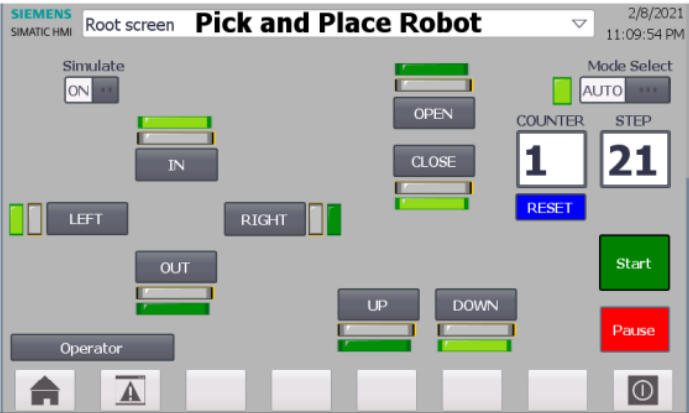
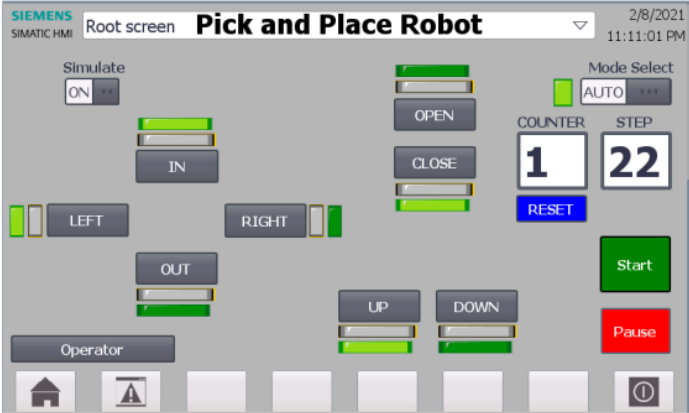


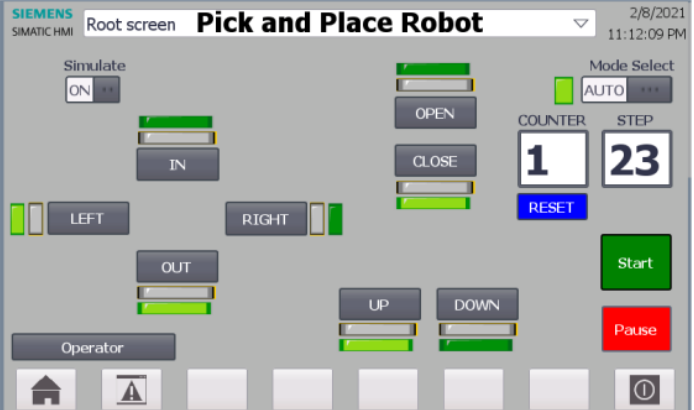
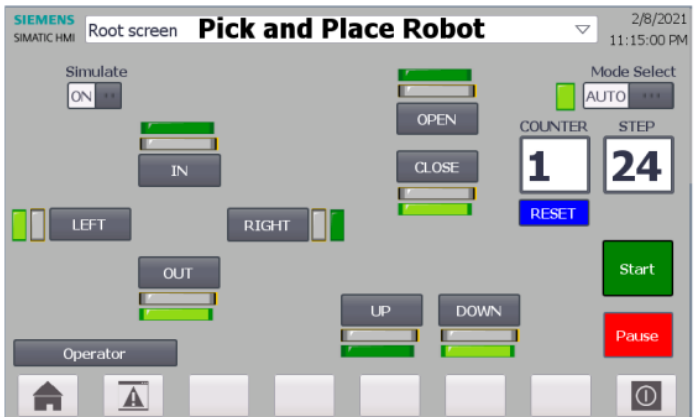
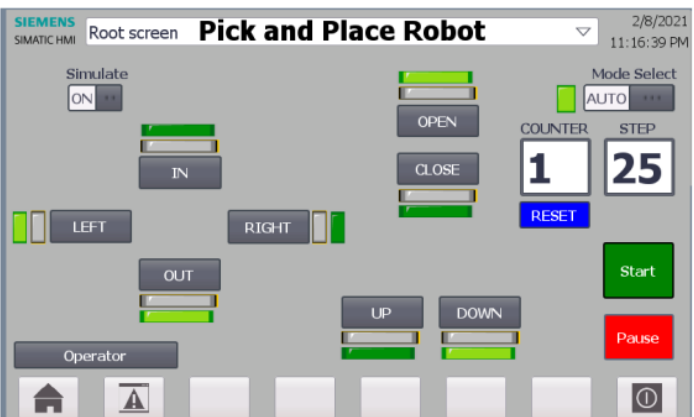
4. Simulation Testing

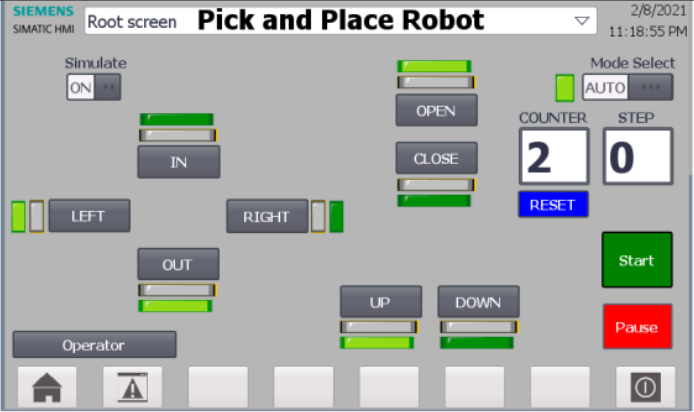
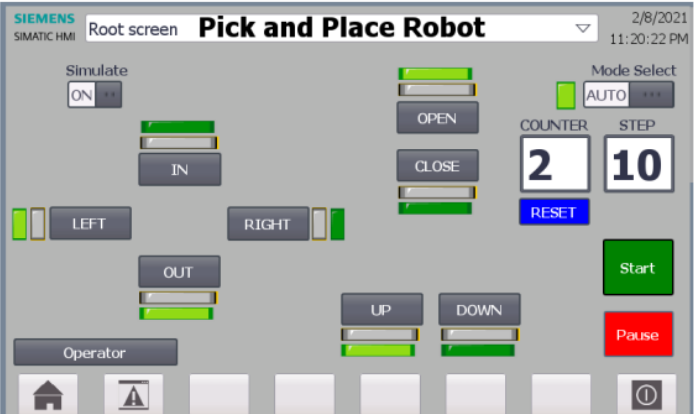
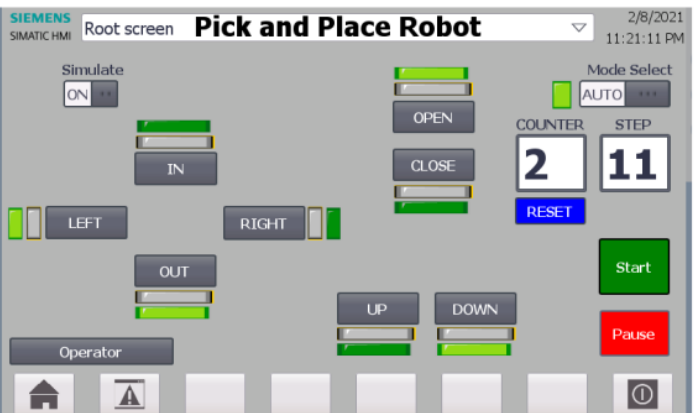
This table should contain 4 main columns, (1) description of test, (2) expected result (3) actual result (4) pass-fail
Poor evidence of testing, missing bits from screens, evidence reference to image in appendix

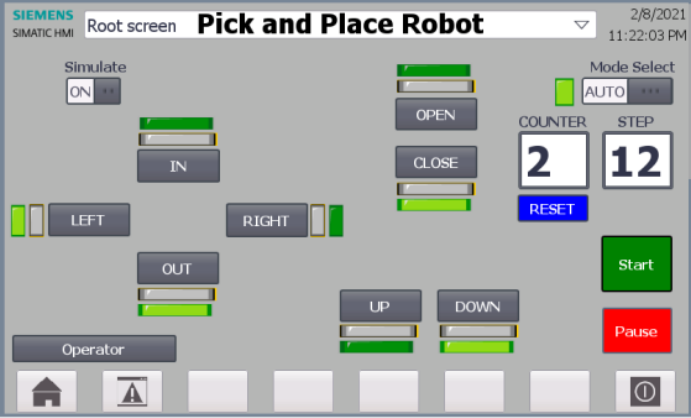
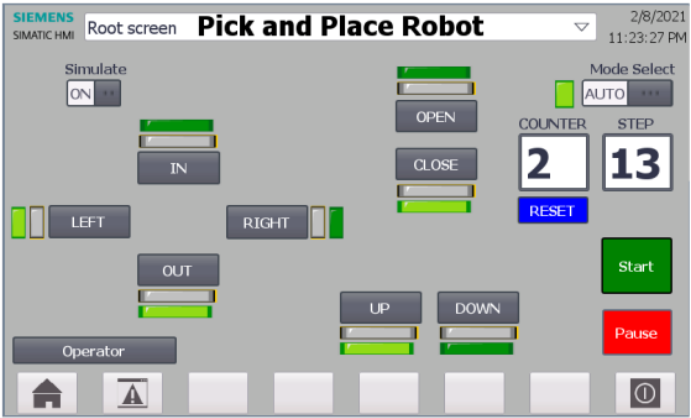
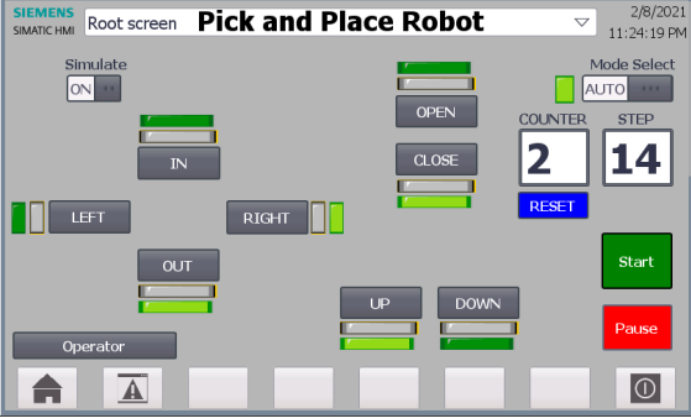
Mode	Testing	Result
Manual	Testing the manual UP solenoid and UP sensor 	Pass
Manual	Testing the manual DOWN solenoid and DOWN sensor 	Pass
Manual	Testing the manual LEFT solenoid and LEFT sensor 	Pass
Manual	Testing the manual RIGHT solenoid and RIGHT sensor 	Pass
Manual	Testing the manual IN solenoid and IN sensor 	Pass
Manual	Testing the manual OUT solenoid and OUT sensor 	Pass
Manual	Testing the manual CLOSE solenoid and CLOSE sensor 	Pass
Manual	Testing the manual OPEN solenoid and OPEN sensor 	Pass

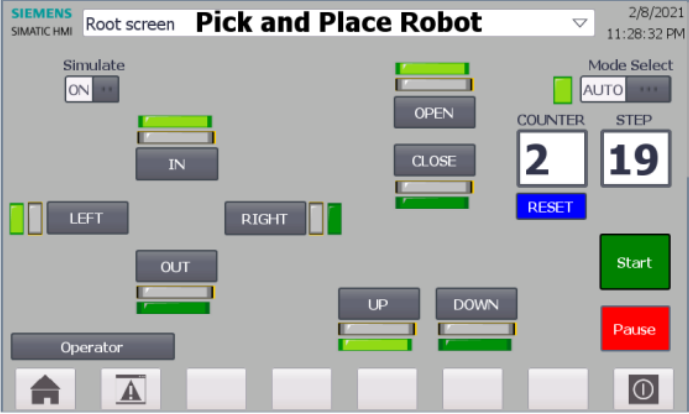
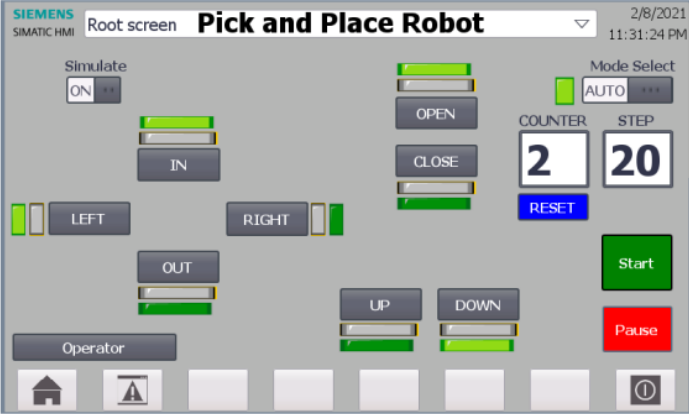
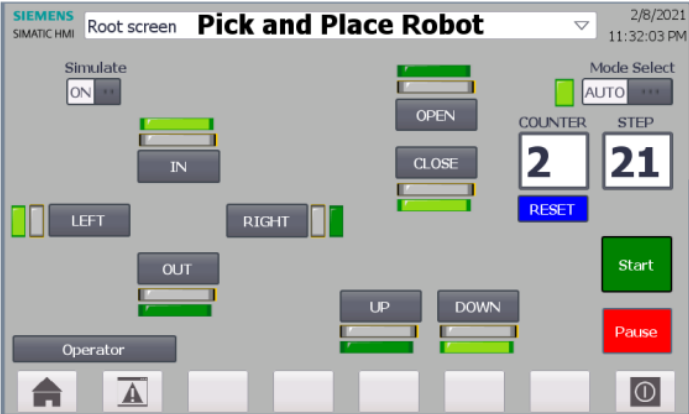
Mode	Testing	Result
AUTO		Pass
AUTO		Pass
AUTO		Pass
AUTO		Pass

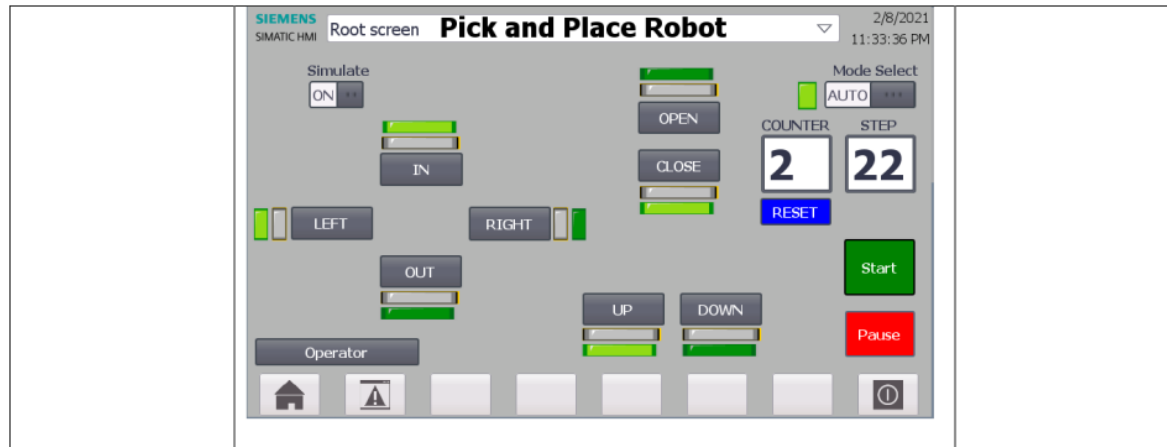
		
AUTO		Pass
AUTO		Pass

AUTO		Pass
AUTO		Pass
AUTO		Pass

AUTO		Pass
AUTO		Pass
AUTO		Pass

AUTO		Pass
AUTO		Pass
AUTO		Pass



Good evidence of testing of sequence

5. Practical Testing and Team Working *This is an acceptable*

explanation
Due to COVID 19 restrictions practical testing could not be completed. In order to complete the teamwork aspect of the assignment we entered a google meet in groups of 3-4 to show our PLC in their working conditions. During the meeting each member took it in turns to share their screens and to run through the operations of the program and to provide feedback regarding any issues or faults within the program. When tested in the group setting the program did not contain issues and was able to run as per specification.

6. Discussion, Conclusions and Recommendations

You don't need to explain what went wrong here
When working on the programming side of the project there had been some issues with conflicting codes and instructions that caused the program to come to a standstill. After investigation using the tools within the system and seeking the help of experienced PLC user the issues were discovered and rectified. With the COVID 19 pandemic practical testing could not go ahead. Other implications the pandemic had on other aspects of the project was the ability to provide evidence and documentation to a high standard. Although the program met the desired specifications time implications prevented the documentation to be completed.

Don't blame a lack of time, this is not appropriate as the brief was issued in November and the submission date was February. Consider better time management.

Talk about the project and any issues and how it meets specification. Explain practical testing issues.*This is not appropriate and should have been deleted*

7. Citation List

Bibliography

Siemens, 2021. *Parmley-Graham*. [Online]
Available at: <https://www.parmley-graham.co.uk/automation/siemens/plc-s/s7-1200-basic-controllers/6ES7211-1BE40-0XB0>
[Accessed 07/02/2021 February 2021].

FINAL GRADE

GENERAL COMMENTS

Instructor

48/100

PAGE 1

PAGE 2

Text Comment. Your first paragraph is an introduction - not required

QM

Correctly cited

Citation method conforms to Harvard standard, well done.

Text Comment. The 1500 is a modular PLC

Text Comment. You should have considered the S7-400 series for rack mounted

QM

Correctly cited

Citation method conforms to Harvard standard, well done.

Text Comment. A good conclusion

Text Comment. Number your pages in the centre at the bottom, use full justification and 1.5 line spacing next time

PAGE 3

Text Comment. A good I/O list but the inputs should have the I addresses listed here not their M addresses which are only for simulation and are mapped to Ms when in non-simulation mode.

Text Comment. This is from the brief - unnecessary to include it

PAGE 4

Text Comment. Is this page intentionally left blank?

PAGE 5

Text Comment. Symbols are missing

Text Comment. These are direct short circuits to ground and should contain symbols of solenoids

PAGE 6

Text Comment. You don't need to explain how to create the program, focus instead on explaining how it works

PAGE 7

Text Comment. You don't need to tell your reader a story of how you created the program

PAGE 8

PAGE 9

Text Comment. You did not include the Annex !!

PAGE 10

PAGE 11

Text Comment. Steps do not contain actions

PAGE 12

PAGE 13

Text Comment. There is no Annex !!

PAGE 14

Text Comment. This table should contain 4 main columns, (1) description of test, (2) expected result (3) actual result (4) pass-fail with evidence reference to image in appendix

Text Comment. Poor evidence of testing, snipping bits from screens proves nothing

PAGE 15

PAGE 16

PAGE 17

PAGE 18

PAGE 19

PAGE 20

PAGE 21

PAGE 22

Text Comment. Good evidence of testing of sequence

PAGE 23

Text Comment. This is an acceptable explanation

Text Comment. You don't need to explain what went wrong here

Text Comment. Don't blame a lack of time, this is not appropriate as the brief was issued in November and the submission date was February. Consider better time management.

Text Comment. This is not appropriate and should have been deleted

PAGE 24

PAGE 25

GRADING FORM: NEW CSG-RUBRIC

JONATHAN DAVIES

48

1. ENGAGEMENT WITH LITERATURE



There is evidence of research form 1 source correctly cited and listed. However, more sources were required and the S7-1500 has been incorrectly stated to be rack mounted which it is not as there is no rack. However, the conclusion to your research task is correct. (8/20)

8

2. KNOWLEDGE AND UNDERSTANDING



There is evidence of knowledge and understanding. A brief explanation of the program was included for some rungs but there is no annex to show evidence of the program. (10/20)

10

3. COGNITIVE AND INTELLECTUAL



There is some evidence of analysis and cognitive skills. Good evidence of testing of the auto sequence but manual testing is poor. Conclusions are not appropriate as sufficient time was allocated. (10/20)

10

4. PRACTICAL APPLICATION



Your drawing has no component symbols. Evidence for testing of manual mode is poor, you have snipped bits out of a screen which is no proof at all. Evidence of auto sequence is very good. Annex is missing, no evidence provided of program coding other than the small amount in the explanation section. (10/20)

10

5. TRANSFERABLE SKILLS



A lot of your words are spent on explaining ow you developed the system and at times, you are telling your reader how it should be done but it is better to explain the finished system as this document is intended to be given to the customer to explain how it works. There are some punctuation an spelling errors. A table of contents and a list of figures should have been added. (10/20)