

2117072

by Daniel Thomas

Submission date: 25-Apr-2023 08:06PM (UTC+0100)

Submission ID: 203411237

File name: 17362_Daniel_Thomas_2117072_181781_934959835.pdf (2.26M)

Word count: 2683

Character count: 15605

Course: HNC Electrical and Electronic Engineering

Module: SGEE4005 Instrumentation and Integrated Automation
Systems

Assignment: 2. Integrated Automation System

Name: Daniel Thomas

University number: 2117072

Date submitted: 25/04/2023

Word count: 2091

Contents

1. Work Plan for Lifelong Learning and Risk Assessment.....	3
2. Research.....	4
3. System Overview and Operation	6
4. Health and Safety, and the Environment	8
5. Maintenance, Reliability and Commercial Risk.....	9
6. Complex System Design – Individual Modifications	10
7. Complex System Design – Team Modifications	11
8. Conclusions and Recommendations.....	12
9. Team Working	13
10. Citation List	14
Works Cited.....	14
11. Appendix	15

Figure 1 ProfiNet : Communications between devices.....	15
Figure 2 Risk Assessment 1	16
Figure 3 Risk Assessment 2	17
Figure 4 Risk Assessment 3	18
Figure 5 Team modifications robot slider	19
Figure 6 Team Modifications robot slider 2	19
Figure 7 Team modifications robot slider 3.....	20
Figure 8 Team Modifications loop data.....	20
Figure 9 Individual modifications Main screen.....	21
Figure 10 Individual modifications Pneumatic station.....	21
Figure 11 Individual modifications Vision station.....	22
Figure 12 Individual modifications Hydraulic Station	22
Figure 13 Individual modifications Assembly station slider	23
Figure 14 Individual modifications Process station	23
Figure 15 Individual modifications water Recirculation	24

1. Work Plan for Lifelong Learning and Risk Assessment

Modifications need to be made to the CIM system, including animating the assembly robot slider and adding Profinet counters to each station and indicators to show the handshaking signals to each PLC. But before this is done a risk assessment will be carried out and completed. As well as this, modifications will also be carried out in groups of three people and the workload will be distributed equally to ensure each person gets a fair experience with the modification process after these modifications are completed testing will be done and evidence gathered to show the system is working.

A useful plan

2. Research

According to MotionControlClips "Machine safety is governed by two standards: EN/ISO 13849-1 and EN/IEC 62061. Both standards are harmonized to the EU Machinery Directive 2006/42/EC, which defines the Essential Health and Safety Requirements (EHSR) for machinery".

SIL stands for Safety Integrity Level, the IEC 61508 was the first international standard for the safety performance of an electrical control system this standard introduced the concept of a lifecycle for the system the main goal of this standard was to minimize the failures in all electrical/electronic and programmable electronic

According to Industrial-Compliance "SILs are measures of performance or dependability for systems featuring safety functions. According to the IEC (or EN) 61508 standards on "Functional safety of electrical / electronic / programmable electronic safety-related systems", there are four SIL bands. The higher the SIL number, the higher the required protection is. (2020) *incorrect citation*

BPX States that "there are different ways to determine the Safety Integrity Level requirements of a given application. IEC 61508 describes both quantitative and qualitative methods to define the appropriate SIL. Common approaches include risk graphs or matrices, fault tree analysis or layers of protection analysis". (2020)*page number?*

As the SIL level increases the system cost will also increase as the higher the SIL level the more complex the system will get. The overall system design will affect the SIL rating most systems rarely need a SIL rating above 2

PL Stands for performance level the safety standard that goes with this is the EN/ISO 13849-1 machine safety standard. This standard uses a qualitative risk graph or flow chart to assign the performance level which is based on three criteria

- Severity of injury
- Frequency of exposure time to hazard
- Possibility of avoiding the hazard and limiting the harm

The EN/IEC 62061 Machine safety standard assigns a safety integrity Level to each function based on the severity of the potential harm, also the probability of the harm occurring

According to Cyber.GC.CA an Industrial Control System is “a general term that includes other types of control systems such as distributed control systems, supervisory control and data acquisition systems, and programmable logic controllers. An ICS uses processes and controls to achieve an industrial objective”. (2021)

The main threat to an Industrial control system is outside people such as hackers. As these people can get into the system and cause real world effects such as turning the machine lights on and off and also causing equipment malfunctions and permanent damage to machinery. There are many ways these hackers can access the system one of the ways is an inside threat to the system, anyone who has access to the system can comprise data for their personal gain or handle the equipment inappropriately from a remote system.

Another way the hackers can access the system is by ransomware which is a virus which is injected into the system which can limit the operation of the machinery. This ransomware asks for money if the money is received the hacker can give access back to the owners of the machinery.

Some of the ways to protect the system is by isolating the system so the virus or hackers can't access any other systems, another way to protect the system is by backing up the systems this should be done offline and should be stored in an offline system this means that if the system is compromised it can be very quickly restored to original working order. Lastly another way to protect the system is by installing a log monitor which can access all relevant information if the system malfunctions or is compromised it can capture all event information for example who had access what actions were performed and what changes were made.

3. System Overview and Operation

Each wagon station has 5 proximity sensors which has a binary pattern of 0 0 1 1 1 = 7 which will detect what wagon is at the station, also each station has a wagon release piston and a wagon at station sensor. Each wagon will have a unique number attached to them through a binary code these inputs are I0.0 to I0.4. These wagons also have a proximity switch. The CIM system has a set point register of four digits 1234.

Digit 1

- 1000 = Empty Wagon
- 2000 = Wagon + Pallet
- 3000 = Wagon + Pallet + Stamp
- 4000 = Wagon + Pallet + Round CH1
- 5000 = Wagon + Pallet + Round CH2
- 6000 = Finished Product

Digit 2

- +100 = Vision Inspection required Stamp
- +200 = VI required CH1
- +300 = VI required CH2

Digit 3

- +10 = Processing required CH1
- +20 = Processing required CH2

Digit 4

- +1 = Vision Inspection result pass stamp
- +2 = VI Result Fail Stamp

- +3 = VI Result Pass CH1
- +4 = VI Result Fail CH1
- +5 = VI Result Pass CH2
- +6 = VI Result Fail CH2

For example when the set point is 3100 the Pneumatic Station is to load an empty wagon with a pallet and a stamp which needs to be inspected. When the inspection has occurred the SP/PV of the specific wagon will be updated to:

SP = 3100

PV = 3000 (Showing wagon+pallet+stamp)

Figure 1 shows the ProfiNet communications between devices (PLC 101 DB30101) contains the data block for storing data to and from PLC 101 this is the same for all the PLC's. (ProfiNet Comms using GET and PUT FB30) and (ProfiNet Comms using GET and PUT_DB DB7) contains the function block and the data block for the GET and PUT into PLC101 the Comms is initiated by PLC 102.

Assembly robot?

4. Health and Safety, and the Environment

Figures 2, 3 and 4 show the risk assessments made on the CIM system these include some risks that were found on the CIM system such as exposed wires on indication lamps this posed a risk of electric shock to anyone who touched these exposed wires, the hazard was found to be negligible but shielding was put over the open cover to prevent electric shock. Another hazard that was found was the boiler and pipes were exposed which will be boiling when turned on. This hazard was found to be negligible but barriers and warning signs were put around the boiler and pipes to prevent people getting too close. The last hazard was there was no lock on the enclosure for the robot arm this means that anyone can open the door and reach inside the enclosure this robot could then cause arm by hitting the person and potentially jamming their fingers. This hazard was found to be negligible, but a lock was added to the door anyway.

There are other hazards such as the slider

5. Maintenance, Reliability and Commercial Risk

The system can be easily maintained by using Vot (View of Things) web page this web page can be accessed from any computer that has the IP address and the password this is a handy tool to use as the engineer doesn't need to be in the building to find the problem in the system they can do it all from a remote building as the program will be fully accessible and can be operated using VoT. This makes the maintenance very easy to complete and also is very reliable.

The system is very vulnerable to hackers as they can easily get into the system and do things such as switch off the lights or even cause the machine to malfunction causing permanent damage these hackers can use ransom Spelling or even buy leaked data off the internet to remotely access the machine and can use ddos attacks on the servers to disrupt the line on the machine. Some of the ways that the system can be protected is by backing up all the files in offline mode and storing them in an offline server so if the system is fully compromised it can be easily restored with the fresh version. Another way to protect the system is by isolating the system when it is comprised this prevents the hacker from accessing other machinery and equipment in the building. Also, a log monitor can be installed that will allow information to be accessed if the system Spelling is compromised. This allows you to capture all event information such as what actions were performed and what changes were made. Write in the third person

6. Complex System Design – Individual Modifications

The modifications that needed to be completed were profinet counters needed to be added to the Engineer main screen along with the slider being animated to move this was done by adding counters and tagging them to the PLC also the slider was animated by adding a move animation to allow it to move left to right for PLC 101, 102, 103, 104, 105 and 106 lights needed to be added for the commands and status for each PLC this was done by putting lights on each of the HMI screens and tagging them to each individual PLC.

Test Number	Expected Result	Actual Result	Pass / Fail	Figure Number
1	Slider should be able to move and the profinet counters should display numbers	Slider moved and the profinet counters displayed numbers	Pass	9
2	The lights on the command and status should turn on	The lights on the command and status turned on	Pass	10
3	The lights on the command and status should turn on	The lights on the command and status turned on	Pass	11
4	The lights on the command and status should turn on	The lights on the command and status turned on	Pass	12
5	The lights on the command and status should turn on	The lights on the command and status turned on	Pass	13
6	The lights on the command and status should turn on	The lights on the command and status turned on	Pass	14
7	The lights on the command and status should turn on	The lights on the command and status turned on	Pass	15

7. Complex System Design – Team Modifications

Figures 5,6 and 7 show the live testing for the CIM system the robot slider is moving across the slider in each screenshot. Also, the screenshots show the profinet counter added into the system on each PLC station. Figure 8 shows the FC535 LC541 and TC511 Loop data this include the SP, PV, Error, KP, KI, KD, CV and a graphic object for the PV. All this testing was done using the VoT web-page

Test Number	Expected result	Actual result	Pass / Fail	Figure number
1	The robot slider should move from left to right and the profinet counters should be working	The robot slider moved left to right and the profinet counters were displaying numbers	Pass	5
2	The robot slider should move from left to right and the profinet counters should be working	The robot slider moved left to right and the profinet counters were displaying numbers	Pass	6
3	The robot slider should move from left to right and the profinet counters should be working	The robot slider moved left to right and the profinet counters were displaying numbers	Pass	7
4	The loop data FC535 LC541 TC511 with their profinet counters SP, PV, Error, KP, KI, KD, CV and the graphic counter for PV should all be displaying data	The loop data FC535 LC541 TC511 with their profinet counters SP, PV, Error, KP, KI, KD, CV and the graphic counter for PV were all displaying data	Pass	8

8. Conclusions and Recommendations

Research has been gathered on how the differences between the two safety legislations and SIL and PL and information was gathered on internet security for industrial interconnected systems. The system was studied in the system overview and a health and safety risk assessment was done to find any health and safety hazards. The system was also studied to see how to carry out maintenance and its reliability. The Cim system was also thoroughly tested through individual modifications which included animating the robot slider and adding lamps for the commands and status of each individual PLC. Groups were also formed to make modifications such as adding profinet counters for each loop data with a graphic counter for the PV. The robot slider was also animated in the group modifications. Overall, what was learned was how a CIM system works and how to add modifications to an existing system and how to carry out risk assessments.

Any recommendations?

9. Team Working

Working as a team has enabled the group to effectively c Write in the third person modifications made to the CIM system. By working as a team, it has enabled us to produce a good outcome as the team modifications workload was equally spread out to ensure everyone got a fair experience, as working as a team is essential for the real world as it will allow us to efficiently work together with co workers and solve problems. Furthermore, it is important to support equality and diversity in the teams as everyone will have a different opinion on the task and teams can also help each other solve problems in the task.

Correct method of listing.

10. Citation List

Works Cited

Borges, V., 2020. *DNV*. [Online]

Available at: <https://www.dnv.com/article/terminology-explained-what-is-safety-integrity-level-sil--207747>

[Accessed 12 April 2023].

BPX, 2020. *BPX*. [Online]

Available at: <https://news.bpx.co.uk/getting-sil-levels-right/>

[Accessed 12 April 2023].

Collins, D., 2019. *Motion Control Tips*. [Online]

Available at: <https://www.motioncontroltips.com/whats-the-difference-between-pl-sil-machine-safety-standards/>

[Accessed 12 April 2023].

Cyber.GC.CA, 2021. *Cyber.GC.CA*. [Online]

Available at: https://www.cyber.gc.ca/sites/default/files/cyber/2021-07/ITSAP.00.050-Security-considerations-for-industrial-control-systems_e.pdf

[Accessed 12 April 2023].

Industrial-Compliance, 2020. *Industrial-Compliance*. [Online]

Available at: <https://industrial-compliance.co.uk/getting-the-safety-integrity-level-right-for-automated-systems/>

[Accessed 12 April 2023].

11. Appendix

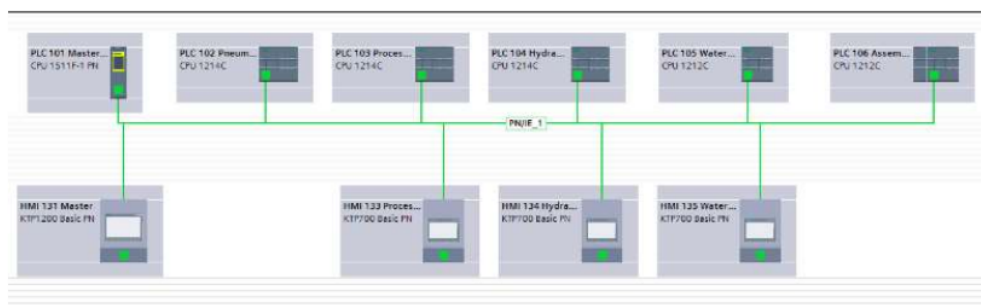


Figure 1 ProfiNet : Communications between devices

Hazard Evaluation			
Hazard Title	Materials with High temperature		
Description	Boiler is exposed along with pipes risks of burns		
			
HR – Risk Estimation & Evaluation			
Degree of Possible Harm	0.5	Possibility of Occurrence	2.5
Possibility of Avoidance	0.75	Frequency of Exposure	3
Hazard Rating Number	2.81	Summary Level	negligible

HRN = DPH x PA x PO x FE

Hazard Mitigation			
Risk Reduction Description	Put a barrier around the boiler and put up warning signs		
Applied Standards			
HR – Risk Mitigation Evaluation			
Degree of Possible Harm	0.5	Possibility of Occurrence	1.25
Possibility of Avoidance	0.75	Frequency of Exposure	3
Hazard Rating Number	1.40	Summary Level	negligible
HR – Possible Residual Risk & Mitigation	Barriers were installed around the boiler and warning signs were put up		

Figure 2 Risk Assessment 1

Hazard Evaluation			
Hazard Title	Moving Elements		
Description	No lock on the door of robot arm there is a risk of the robot arm hitting you and jamming fingers		
			
HR – Risk Estimation & Evaluation			
Degree of Possible Harm	3	Possibility of Occurrence	1.25
Possibility of Avoidance	0.75	Frequency of Exposure	3
Hazard Rating Number	8.4375	Summary Level	negligible

HRN = DPH x PA x PO x FE

Hazard Mitigation			
Risk Reduction Description	Lock should be added on door to prevent people reaching in and the robot arm hitting them		
Applied Standards			
HR – Risk Mitigation Evaluation			
Degree of Possible Harm	0.25	Possibility of Occurrence	1.25
Possibility of Avoidance	0.75	Frequency of Exposure	3
Hazard Rating Number		Summary Level	negligible
HR – Possible Residual Risk & Mitigation	Lock was added onto the door		

Figure 3 Risk Assessment 2

Hazard Evaluation			
Hazard Title	Live Parts		
Description	Exposed wires for lamps risk of electrocution and a risk of a fire from bad crimping		
			
HR – Risk Estimation & Evaluation			
Degree of Possible Harm	0.5	Possibility of Occurrence	2.5
Possibility of Avoidance	0.75	Frequency of Exposure	5
Hazard Rating Number	4.68	Summary Level	negligible
HRN = DPH x PA x PO x FE			
Hazard Mitigation			
Risk Reduction Description	Put shielding over the open cover to prevent people touching the live parts		
Applied Standards			
HR – Risk Mitigation Evaluation			
Degree of Possible Harm	0.25	Possibility of Occurrence	0.05
Possibility of Avoidance	0.75	Frequency of Exposure	5
Hazard Rating Number		Summary Level	negligible
HR – Possible Residual Risk & Mitigation	Shielding was added over the open cover		

Figure 4 Risk Assessment 3



Figure 5 Team modifications robot slider



Figure 6 Team Modifications robot slider 2



Figure 7 Team modifications robot slider 3

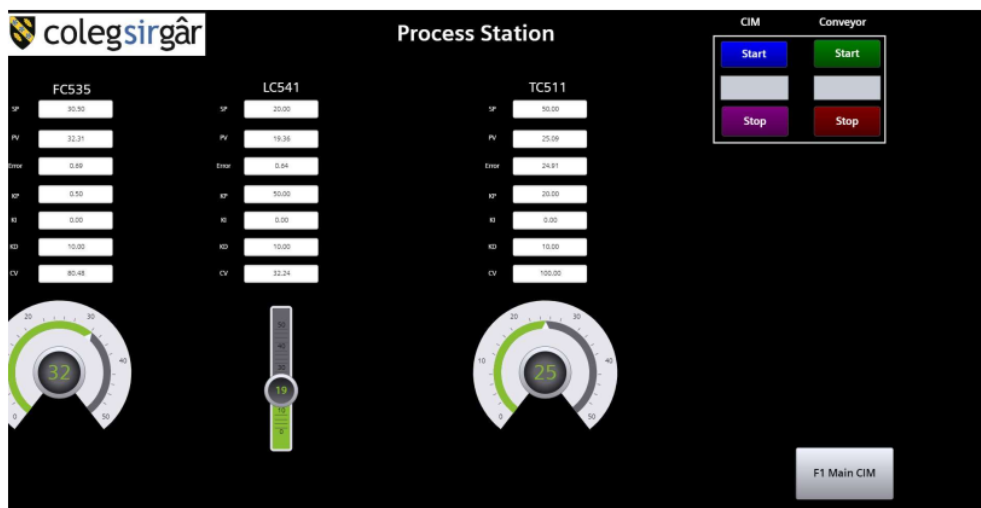


Figure 8 Team Modifications loop data

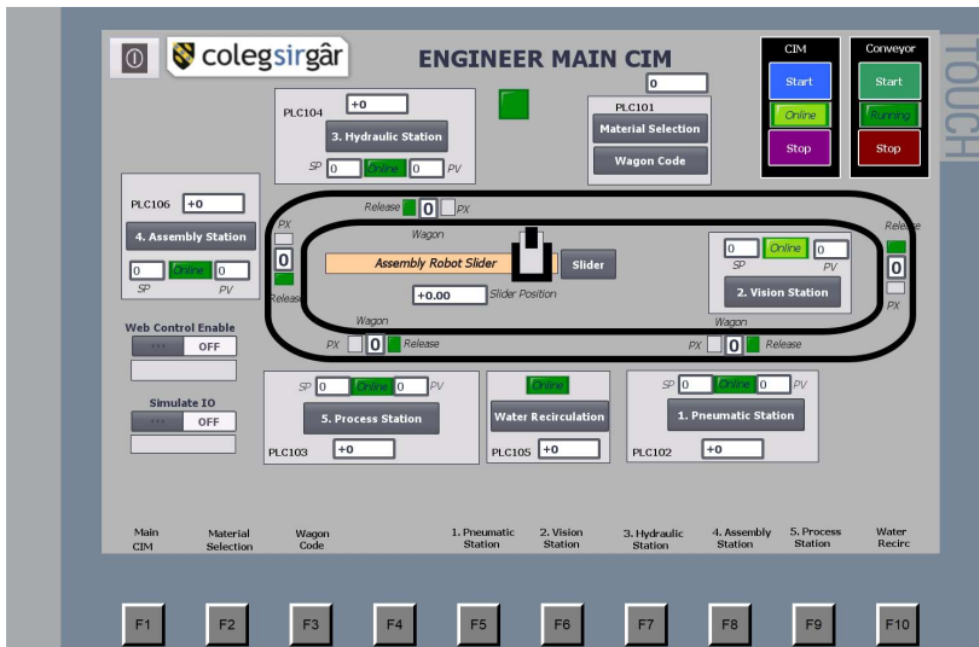


Figure 9 Individual modifications Main screen

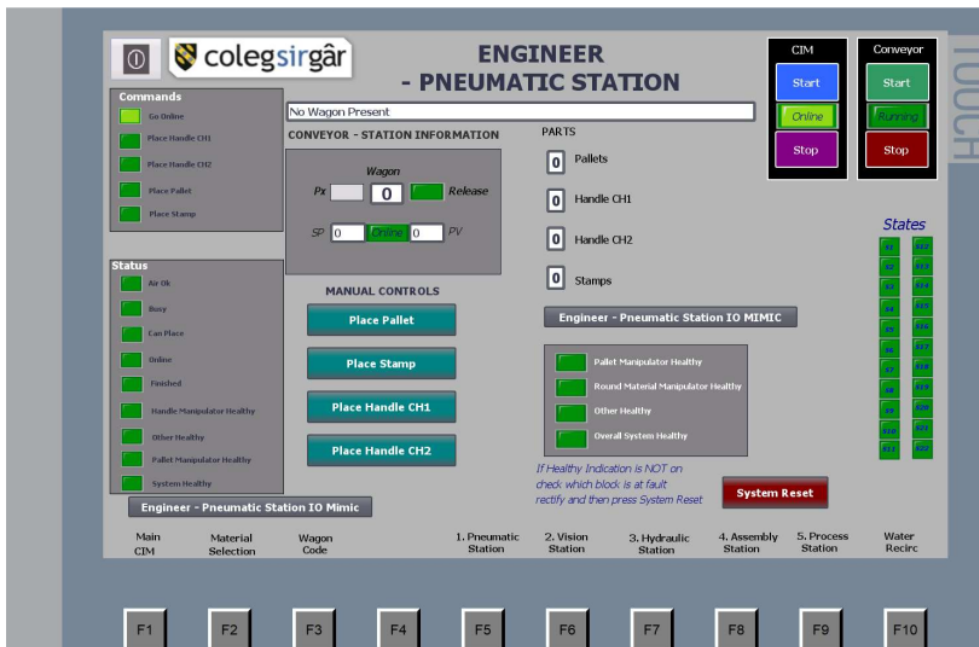


Figure 10 Individual modifications Pneumatic station

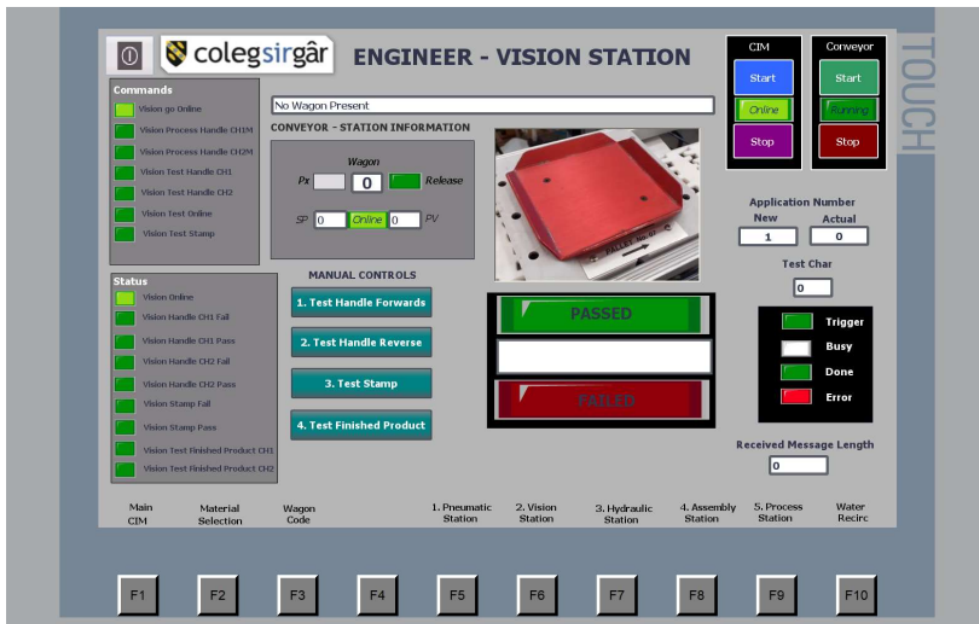


Figure 11 Individual modifications Vision station

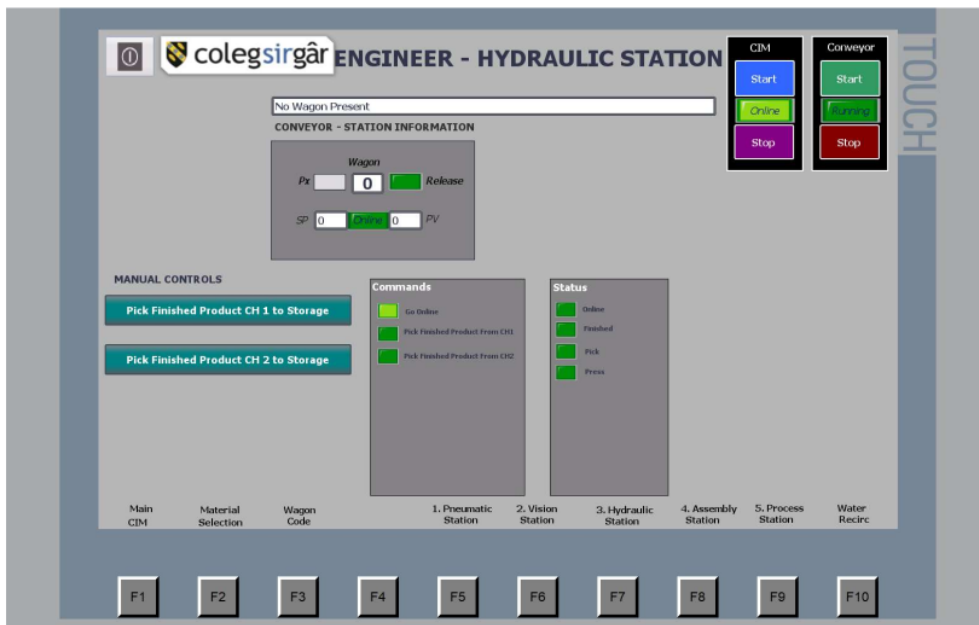


Figure 12 Individual modifications Hydraulic Station

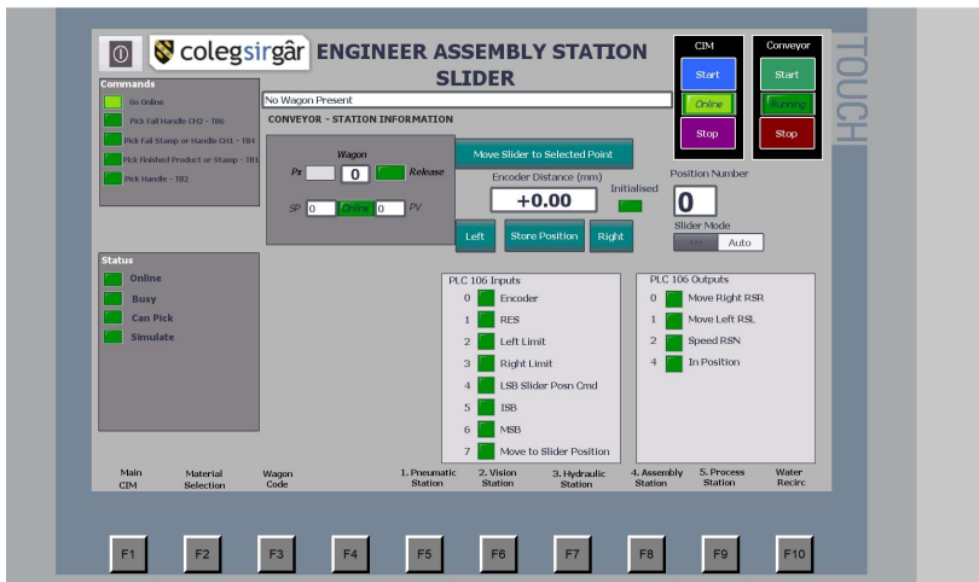


Figure 13 Individual modifications Assembly station slider

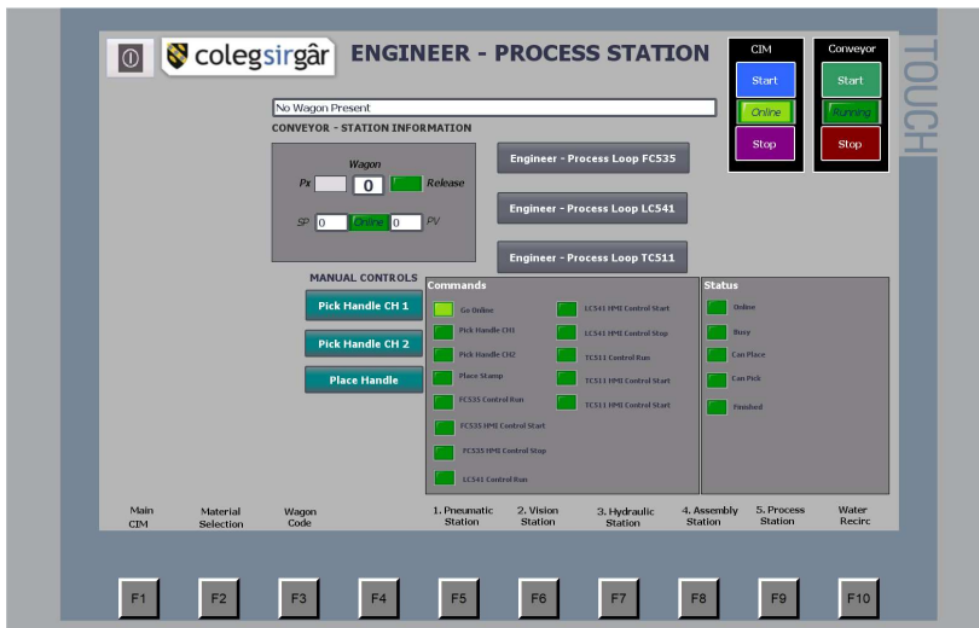


Figure 14 Individual modifications Process station

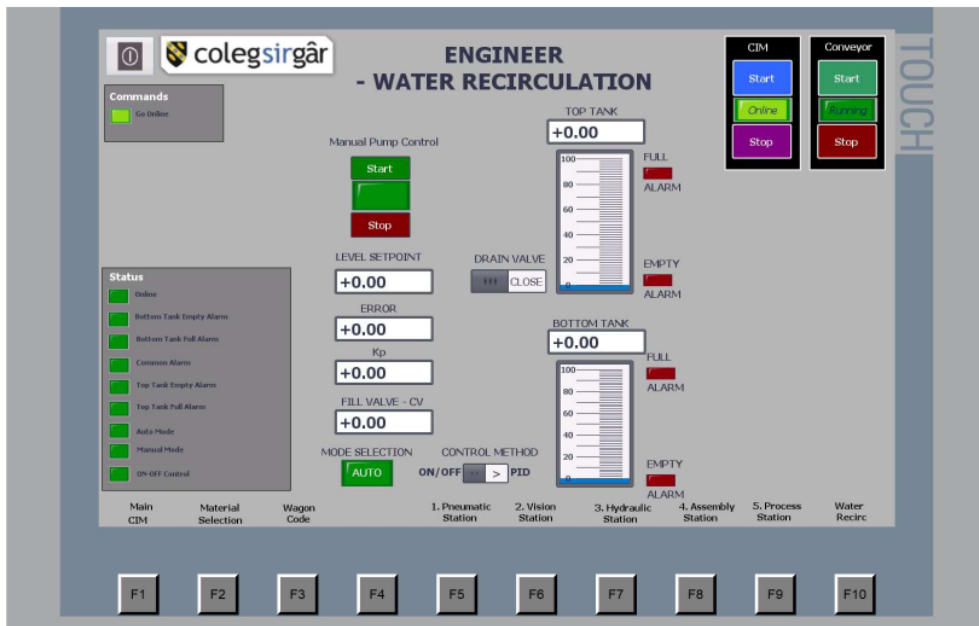


Figure 15 Individual modifications water Recirculation

FINAL GRADE

GENERAL COMMENTS

Instructor

59/100

PAGE 1

PAGE 2



Good Structure

Report is structured exactly as stated in the assignment brief.

PAGE 3

Text Comment. A useful plan

PAGE 4

Text Comment. incorrect citation

Text Comment. page number?

PAGE 5

PAGE 6

PAGE 7

Text Comment. Assembly robot?

PAGE 8

Text Comment. There are other hazards such as the slider

QM

Spelling

Spelling error

QM

Spelling

Spelling error

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".

QM

Spelling

Spelling error

Text Comment. Any recommendations?

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".

QM

Correct method of listing.

You have listed your sources correctly according to the Harvard method.

GRADING FORM: NEW CSG-RUBRIC

DANIEL THOMAS

59

1. ENGAGEMENT WITH LITERATURE



The research section has some evidence of reading from a small range of sources listed and but not always cited correctly using the Harvard method as seen in sections 2 and 10. 10/20

10

2. KNOWLEDGE AND UNDERSTANDING



Some knowledge and understanding demonstrated in all report sections and particularly sections 3, 4 and 5. 10/20

10

3. COGNITIVE AND INTELLECTUAL



Good evidence of analysis through testing with a good testing table for results, with good conclusions

14

and recommendations. 14/20

4. PRACTICAL APPLICATION



Good evidence of practical work both with individual system modifications with simulation and with team work on VoT web server mods. 13/20

13

5. TRANSFERABLE SKILLS



A good work plan but no risk assessment. Good explanation of team working. Report is well structured, and correctly presented. Good clear diagrams. Word count not exceeded. You must learn to use the third person. 12/20

12