

2017196

by Jack Rogers

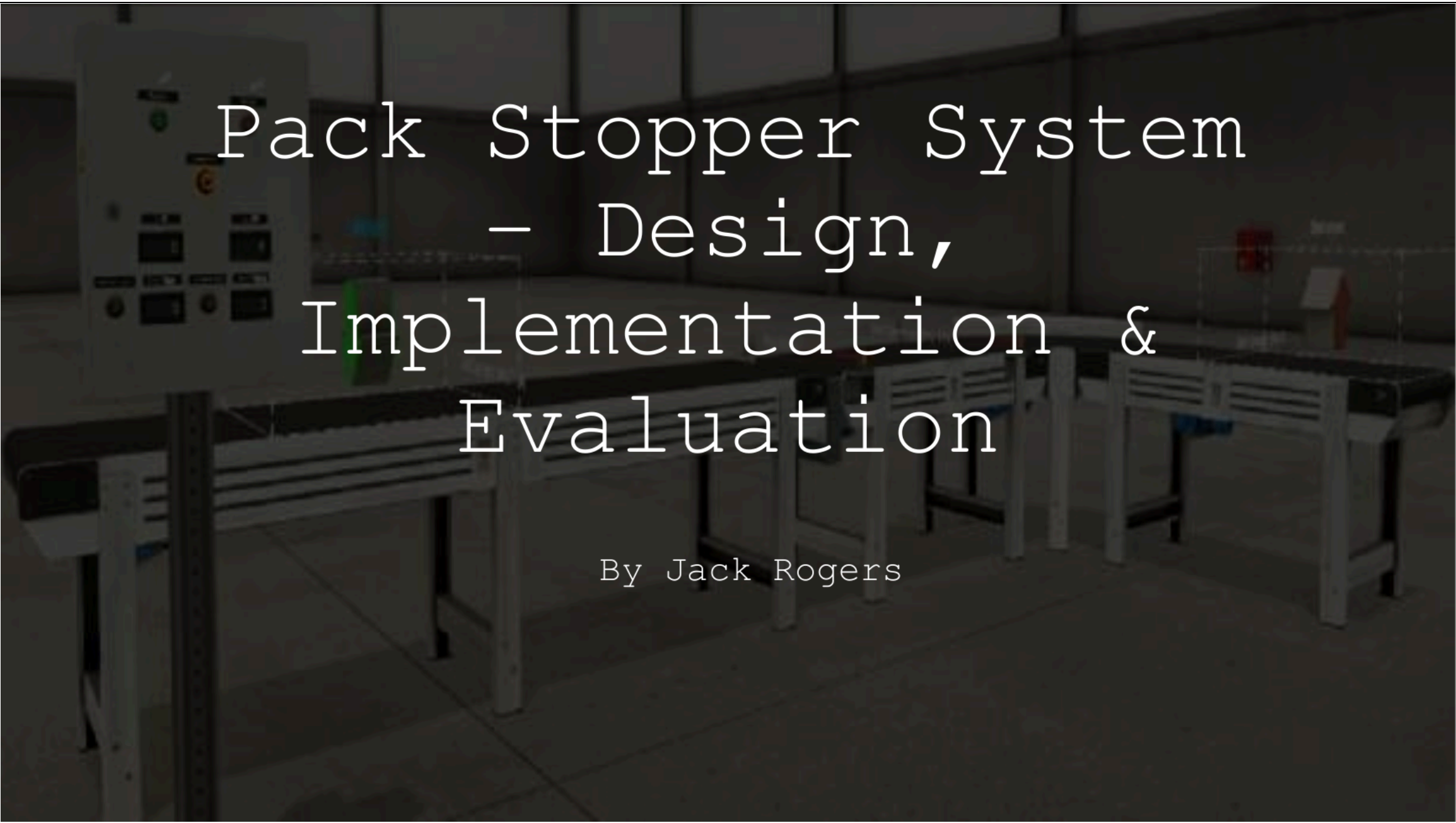
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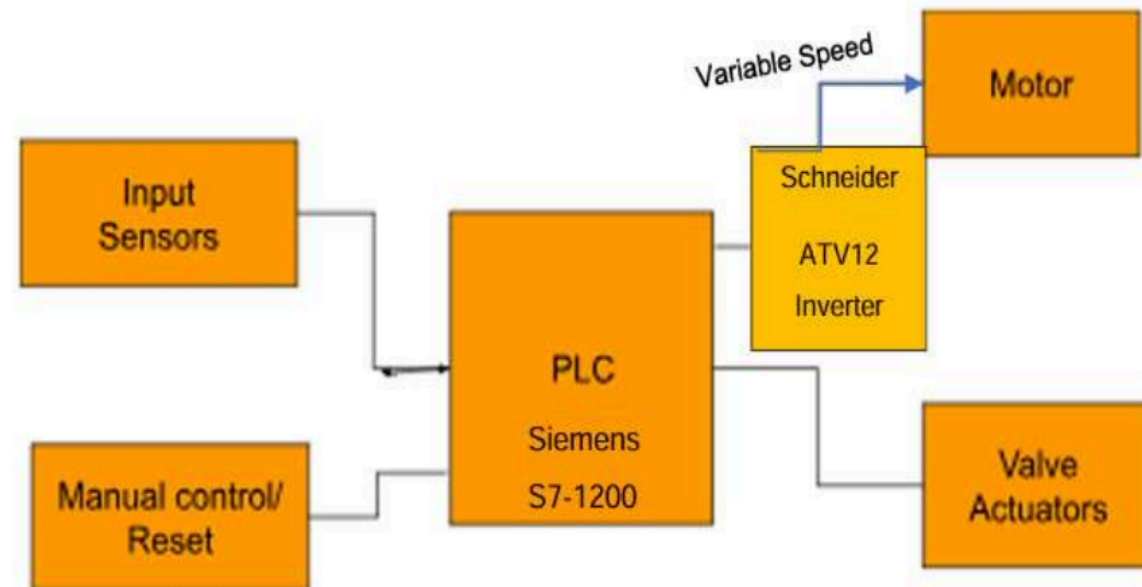


Pack Stopper System – Design, Implementation & Evaluation

By Jack Rogers

Project Aims & Objectives

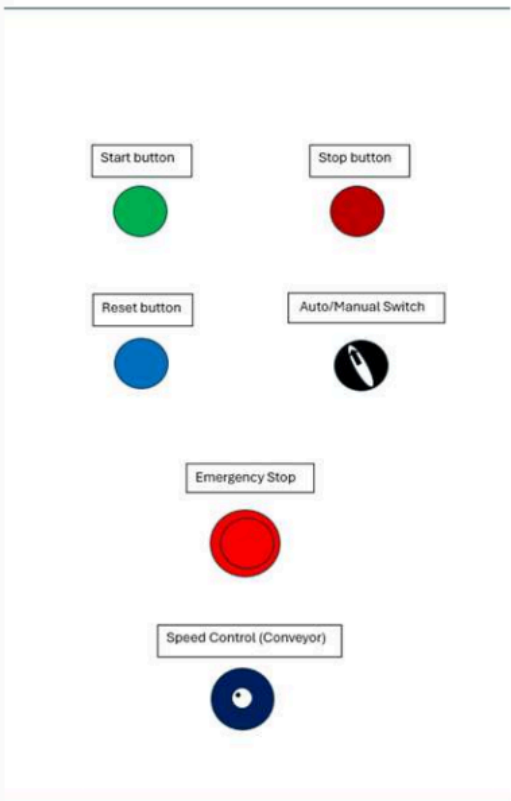
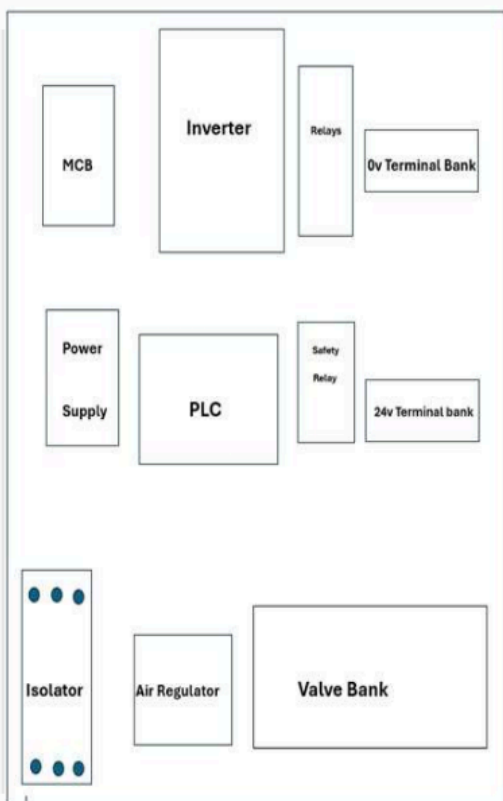
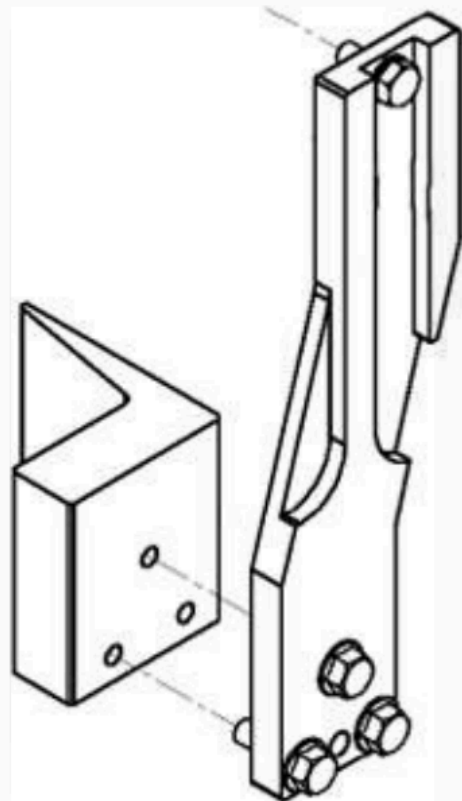
- Improve production efficiency
- Reduce downtime and waste
- Design pack stopper with PLC & HMI control
- Validate system via simulation



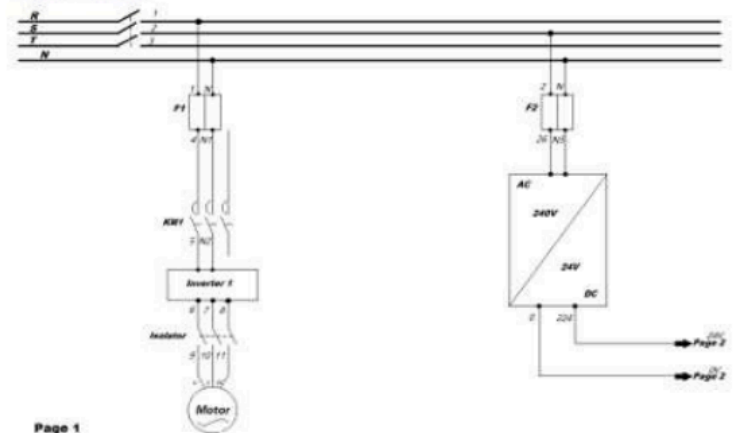
Changes to Functional Design Specification (FDS)

Functional Specification Design		
Criteria/Ref No.	Requirement	Updated Requirements
I.1	The new panel must be no smaller than that H = 400mm x W = 300mm x D= 200mm.	This cannot be achieved due to project being simulated and not physically built.
F.1	Panel must have a Start LED Indicator	This can be achieved by a simulated panel by using Factory IO.
F.2	The new panel will include a Stop control	This can be achieved by a simulated panel by using Factory IO.
F.3	The new panel will include a LED Reset button	This cannot be achieved due to project being simulated and not physically built.
F.4	A start control will be included on the new panel.	This can be achieved by a simulated panel by using Factory IO.
F.5	The system must have a Speed control method to operate from the new panel	This can be achieved by a simulated panel by using Factory IO.
F.6	The Stopper cylinders must be able to fire manually	This cannot be achieved due to project being simulated and not physically built.
F.7	Stoppers must remain closed until pack arrives	This cannot be achieved due to project being simulated and not physically built.
F.8	Stoppers must Release when pack arrives	This can be achieved by a simulated panel by using Factory IO.

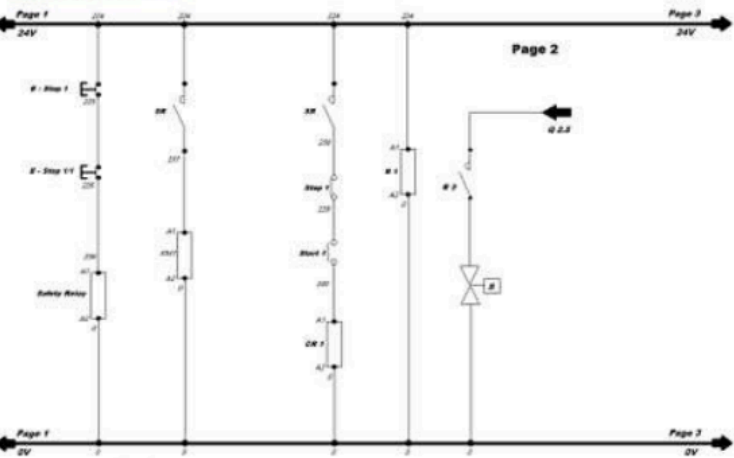
System Design Overview



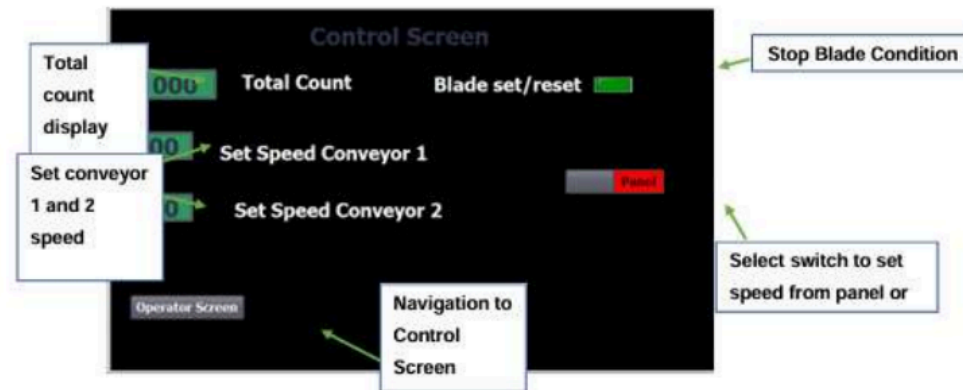
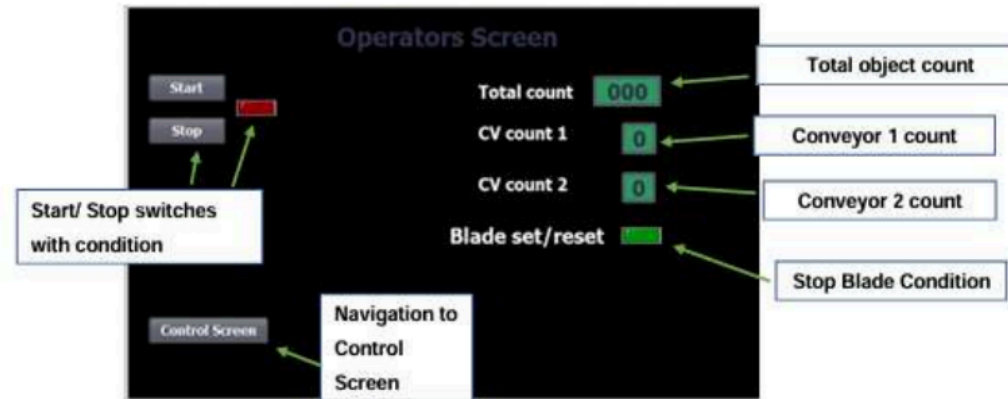
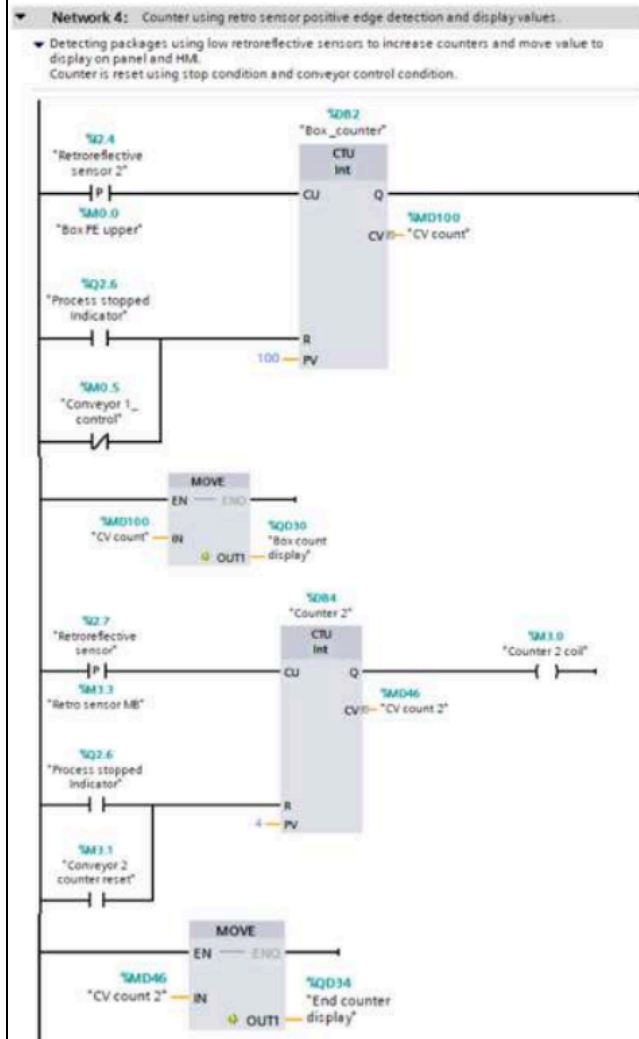
Power Circuit



Control Circuit 1



Construction Phase



Testing and analysis of results

$$1 \times 5 = 5 \text{ Seconds}$$

$$5 + 5 = 10 \text{ Seconds}$$

$$\frac{60}{10} = 6$$

$$6 \times 5 = 30 \text{ Packs Per Minute}$$

Test No	HMI Conveyor 1 Speed Set	HMI Conveyor 2 Speed Set	No of Objects Detected	Stop Blade Activated	Reset Timers after 5 Objects	HMI Stop Function Activation	HMI Start function with Auto Blade Reset	Sequence continues in Auto Mode	HMI Total Count	Pass / Fail
1	10	12	5	Pass	Pass	Pass	Pass	Pass	Pass	Pass
2	12	14	5	Pass	Pass	Pass	Pass	Pass	Pass	Pass
3	14	16	5	Pass	Pass	Pass	Pass	Pass	Pass	Pass
4	16	18	5	Pass	Pass	Pass	Pass	Pass	Pass	Pass
5	18	20	5	Pass	Pass	Pass	Pass	Pass	Pass	Pass
6	20	22	5	Pass	Pass	Pass	Pass	Pass	Pass	Pass

Speed Set (%) Conveyor 1	Speed Set (%) Conveyor 2	Image Evidence Conveyor 1	Image Evidence Conveyor 2
10	12		
12	14		
14	16		
16	18		
18	20		

- Test results show a 100% pass rate
- Results show the rate of packs per minute
- System complies with the FDS

Evaluation of Project Outcomes

- Met the FDS criteria

Test Plan Table					
Criteria/Ref No.	Requirement	Test Description	Expected Result	Decision Pass/Fail	Evidence
F.1	Panel must have a Start LED Indicator	Start the system for the panel.	System will run, and the Start LED will come on.	Pass	Figure 47
F.2	The new panel will include a Stop control	While the system is running, press the stop button on the new panel.	The system will stop.	Pass	Figure 46
F.4	A start control will be included on the new panel.	While the system is on stop and all faults have been reset, press the start button on the new panel.	The system will start.	Pass	Figure 47
F.5	The system must have a Speed control method to operate from the new panel	Turn the speed control all the way to the left and then all the way to the right.	The system will decrease in speed and then increase in speed.	Pass	Tables 9 and 10
S.1	The Emergency Stop button will be included on the new panel	Press the emergency stop button on the new panel while the system is operating.	Machine should stop running instantly and the reset LED should come on.	Pass	Figure 46
D.1	The system must be able to know how many packs goes into the machine	Put 5 packs onto the infeed conveyor of the machine.	The HMI of the existing machine shows that 5 packs have entered the sealing station.	Pass	Figures 49 and 50
D.2	The system must be able to read the speed of the infeed conveyor in terms of packs per minute	Load up the infeed conveyor full of packs continuously.	The HMI of the existing machine shows the rate of PPM the Infeed conveyor is running at.	Pass	Tables 9 and 10
D.3	The machine must be able to count how many packs per minute (ppm) the system is actually producing.	Load up the infeed conveyor full of packs continuously.	The HMI of the existing machine shows the rate of PPM the system is producing.	Pass	Figures 49 and 50

Management & Planning

	January 3rd	January 10th	January 17th	January 24th	January 31st	February 7th	February 14th	February 21st	February 28th	March 7th	March 14th	March 21st	March 28th	April 4th	April 11th	April 18th	April 25th
Buying	Expected	Expected	Expected	Expected	Expected	Expected	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual
Design Stoppers	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual
Programming	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual
Simulate	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual
Create Wiring Diagram	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual
Wiring Panel	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual
Testing Panel	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual
Create Air Supply	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual
Manufacture Stopper Arms	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual
Build Complete Project	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual
Test Project	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual
	Expected	Expected	Expected	Expected	Expected	Expected	Expected	Expected	Expected	Expected	Expected	Expected	Expected	Expected	Expected	Expected	Expected
	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual
	Behind Target	Behind Target	Behind Target	Behind Target	Behind Target	Behind Target	Behind Target	Behind Target	Behind Target	Behind Target	Behind Target	Behind Target	Behind Target	Behind Target	Behind Target	Behind Target	Behind Target

Costing Spreadsheet for Project

Components	Predicted Cost	Actual Cost
Labour 48 (Hours)	£700	£823
PLC (Siemens Simatic S7 1211c)	£300	£210
Inverter (Schinder ATV12 Single to 3 phase 0.33Kw)	£150	£120
Relays 24v	£20	£27
Panel (Schinder stainless steel)	£250	£300
Start button (Schinder 24v)	£10	£12
Stop button (Schinder 24v)	£10	£12
Reset Button (Schinder 24v)	£10	£12
Wiring (1.5mm cable)	£30	£25
Siemens Power Supply (	£80	£100
E-stop Button (Schinder 24v)	£15	£12
Contactors	£50	£48
Retroflected Sensors	£100	£95
Pusher cylinder	£40	£45
Pack stoppers	£100	£150
Total	£1,815	£1,991
Budget	£2,000	

Conclusions & Recommendations

✓ Simulated system to prove theory

✓ Increased throughput to 30 ppm

✓ Stayed within budget • Hardware implementation (pack stoppers, guards)

✗ Timescale overrun

- Adjustable pack count via HMI
- Data logging on HMI
- Use of Factory IO for future training



Prototype Demo

Pack Stopper Project - Factory IO

A 3D rendering of a field of dark grey dollar signs (\$). In the center, a single, bright orange question mark (?) stands out. The text "Any Questions?" is overlaid in a white, serif font, positioned behind the orange question mark.

Any Questions?

FINAL GRADE

GENERAL COMMENTS

66/100

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JACK ROGERS

66

1. ENGAGEMENT WITH LITERATURE

2. KNOWLEDGE AND UNDERSTANDING

- 

Project design

Some design shown though no schematics or flow charts presented (7/10)

Project implementation

Program clip, mechanical components and Factory IO shown, very good implementation by simulation (7/10)

Response to questions

Generally good but couldn't explain the program very well or the setup of the inverter (5/10)

19

19/30

3. COGNITIVE AND INTELLECTUAL



Testing and analysis of results

A good table with good results shown (7/10)

Critical evaluation of the project outcomes relating to FDS and constraints

Good but briefly stated (6/10)

Conclusions and recommendations

Very good (7/10)

20/30

20

4. PRACTICAL APPLICATION



Deployment method, use of material, tools, equipment and techniques in the construction of the project.

Mainly software simulation and the use of Factory IO (7/10)

Quality of the final product or system

Very good simulation with panel matching design (7/10)

Management of the design process including use of plans, costing spreadsheet

Some evidence presented (6/10)

20/30

20

5. TRANSFERABLE SKILLS



Quality of the presentation slides

Generally very good (4/5)

Quality of the delivery style

Very good (3/5)

7/10

7