

1708165

by Adam Bedner

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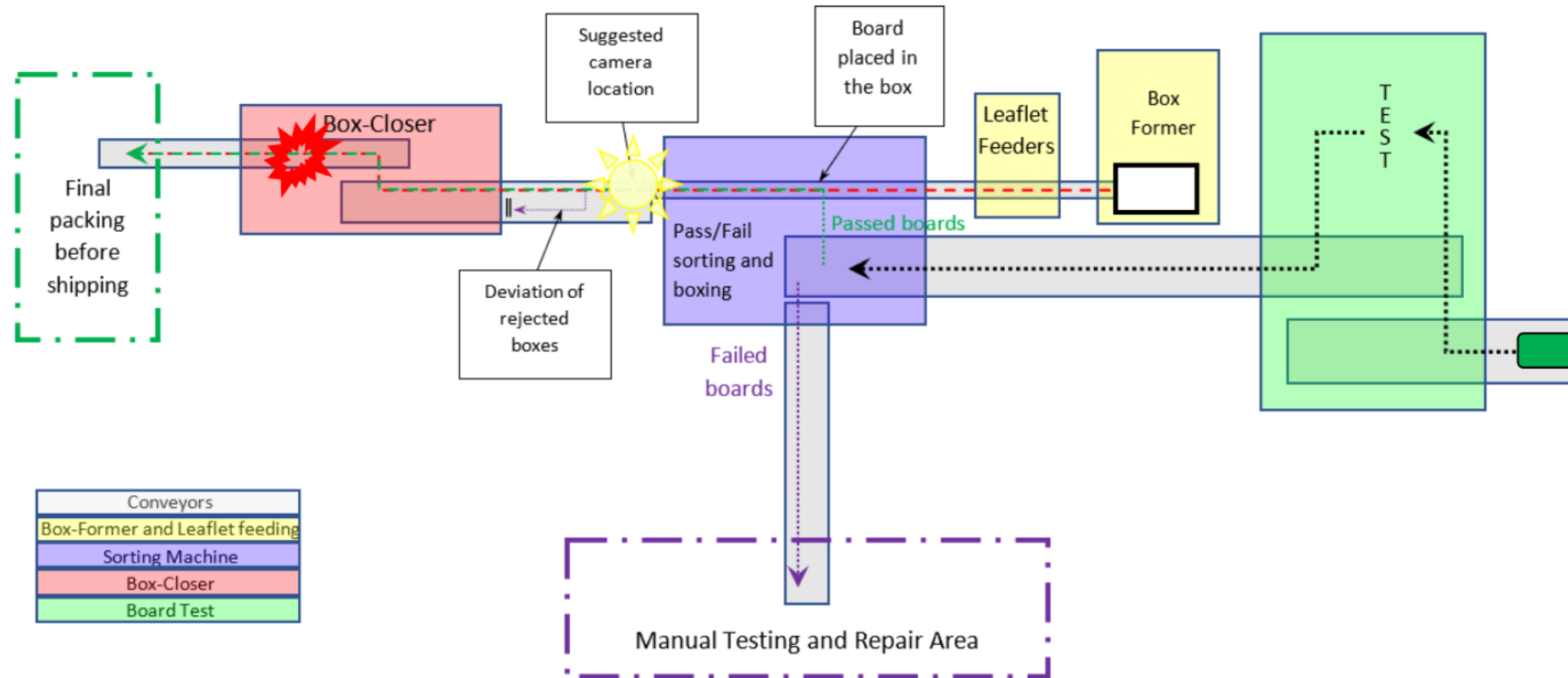
Project Definition Research and Quality Planning

BSc (Hons) Electrical and Electronic Engineering

SGEL6000 Independent Project

By: Adam Bedner

Project Background and Problem Definition





Project Constrains

- Any high voltage above the safety voltage limit (25VAC or 55VDC) has to be clearly labelled
- Similarly, all high-pressure air systems has to be clearly labeled and isolation valve has to be easily accessible.



Project Constrains

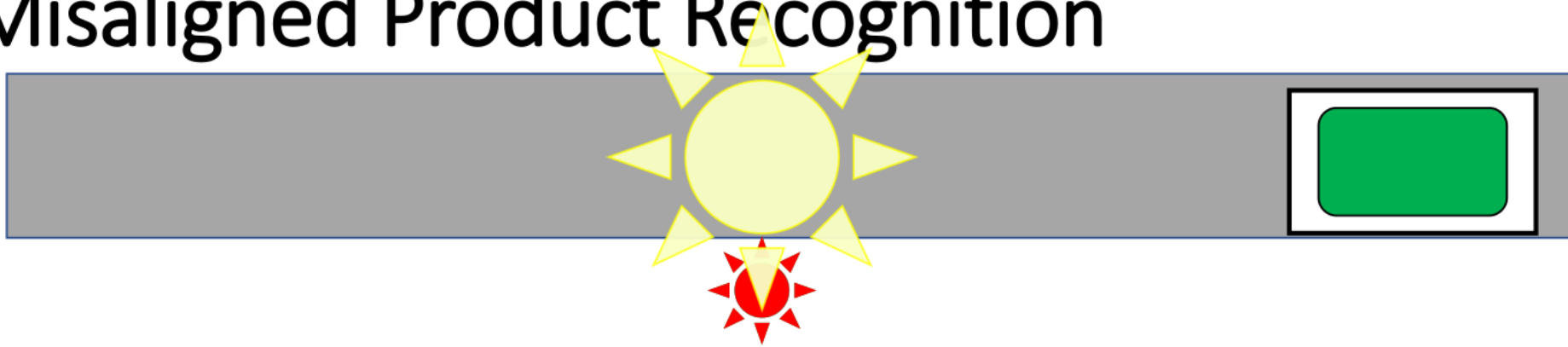
- Any delayed deliveries can set the project back and are a major risk for missing the project's deadline.



Functional Design Specification

- Misaligned product recognition
- Compatibility with different models
- Cooldown time no longer than 3 seconds
- Jam up detection
- Misfire detection
- IIOT Ready
- Minimal machine modification required for installation
- No interference with existing safety systems
- Cat 4 safety compliant

Misaligned Product Recognition

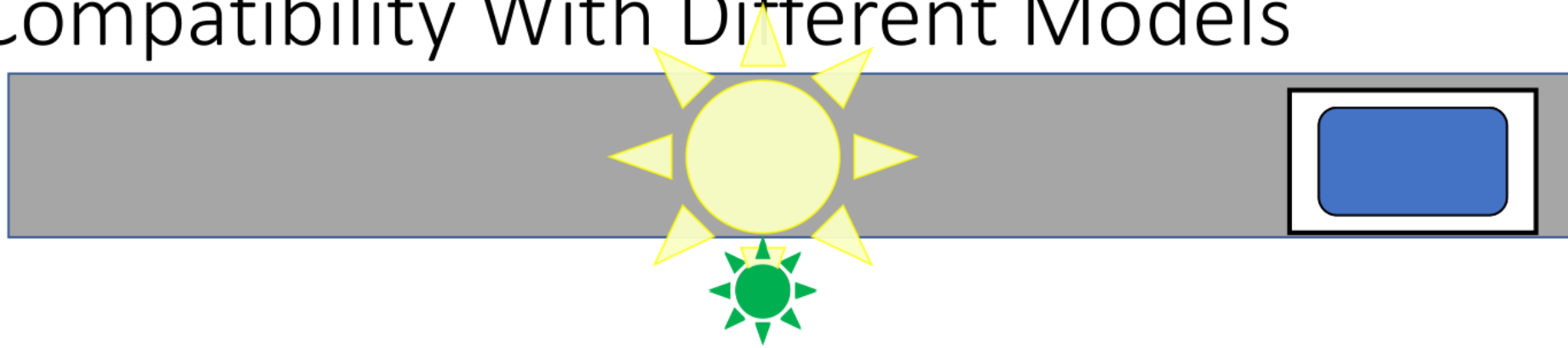


The system has to recognise if the product has been misaligned withing the box.

Testing Plan

Run the machine and misplace the product in varying severity; expecting for every misaligned product to be rejected; regardless of the severity

Compatibility With Different Models

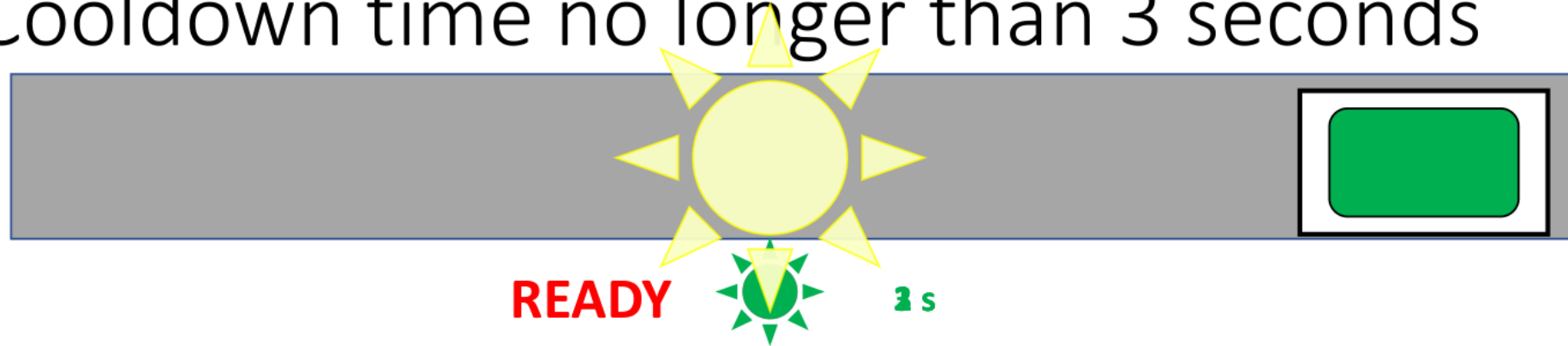


Given that the line can test and pack more than one model,
the system must work with multiple products

Testing Plan

It will be essential to run all products that the line is cable of testing and packing while ensuring that the system still can differentiate misplaced products.

Cooldown time no longer than 3 seconds

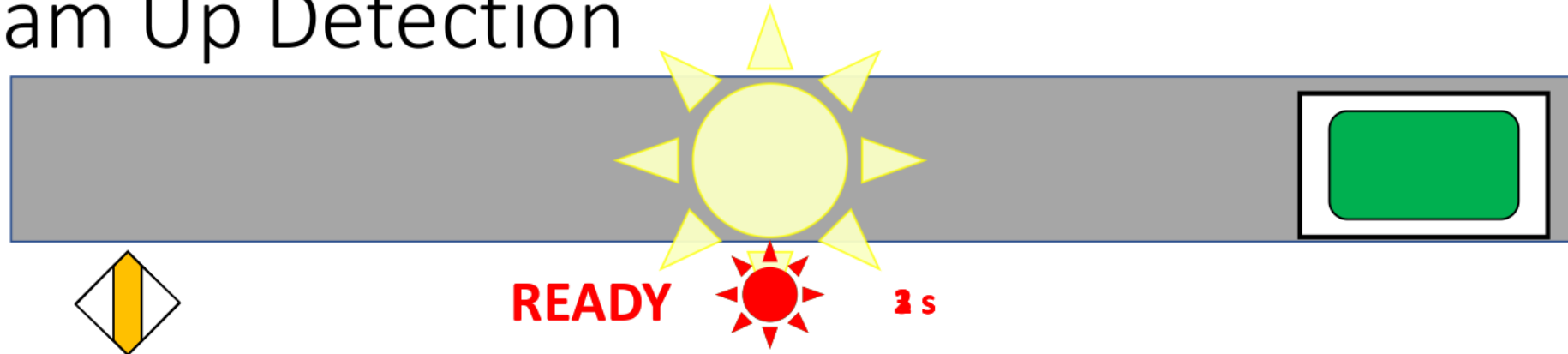


The system must have a maximum cooldown time of 3 seconds or shorter due to speed of the line

Testing Plan

While performing previously mentioned tests, record the timings through the feedback on the serial monitor. The system will be programmed to show test times.

Jam Up Detection

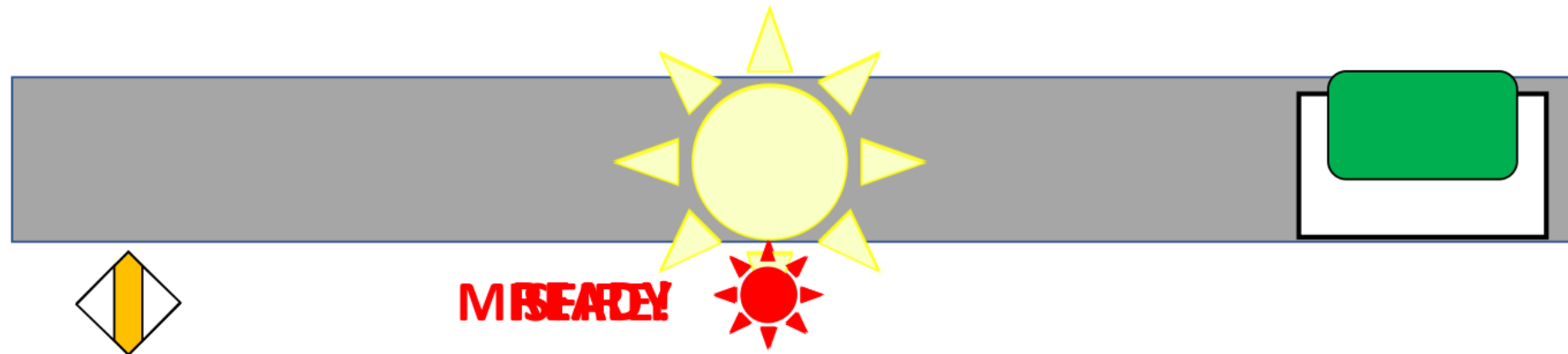


The system will have to be able to detect a jam or build up of product going into the box closer (can be caused by an abnormal stop of box closer). When that happens the system will send a stop signal and alarm.

Testing Plan

An abnormal stop will be simulated by triggering the safety system. Also, simulating it by placing an obstruction across the conveyor.

Misfire Detection



The system must be capable of detecting a misfire condition where a reject box is not rejected. In such case the system must send a immediate stop signal to box closer and sound the alarm

Testing Plan

Simulate a misfire condition by disabling the rejecting actuator. Record the results.

IIOT Ready

The system must be compatible with IIOT systems connected through Ethernet connection. It must send the pass/fail data together with pictures of the fails to the IIOT server.

Testing Plan

For this test the IIOT department must be involved, requesting to monitor the received data from the system.

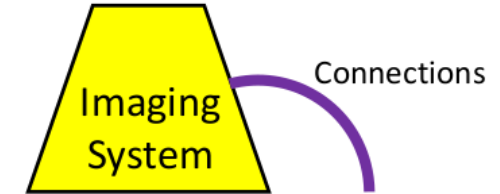


Minimal Machine Modification on Installation

The system is required to modify the existing machine as little as possible for installation. It must not require major modifications.

Testing Plan

Provide proof of minimal modifications to existing machine with descriptive notes and photographic evidence



SYSTEM
READY!

Existing Machine

No Interference With Existing Safety Systems



The system must not interfere with any of the existing machine's safety systems.

Testing Plan

Test all safety system prior to any installations are made and record all safety system behaviour.

Once installation is complete, re-do the tests, record behaviour and compare it with the pre-installation recordings.

Cat 4 Safety Compliant

All required safety systems, if any needed, must conform with CAT4 Safety

• **SAFETY FIRST** • **SAFETY FIRST** • **SAFETY FIRST** •

Testing Plan

Test the functionality of the safety systems.

Simulate faults within the safety system by
disconnecting cables at different points of the systems.

Make sure that the system is still operational with single
points of failure simulated and that the single points of
failure are detected by the system.

Literature Review

Three possible solutions for the problem are being presented:

Xilinx image processing

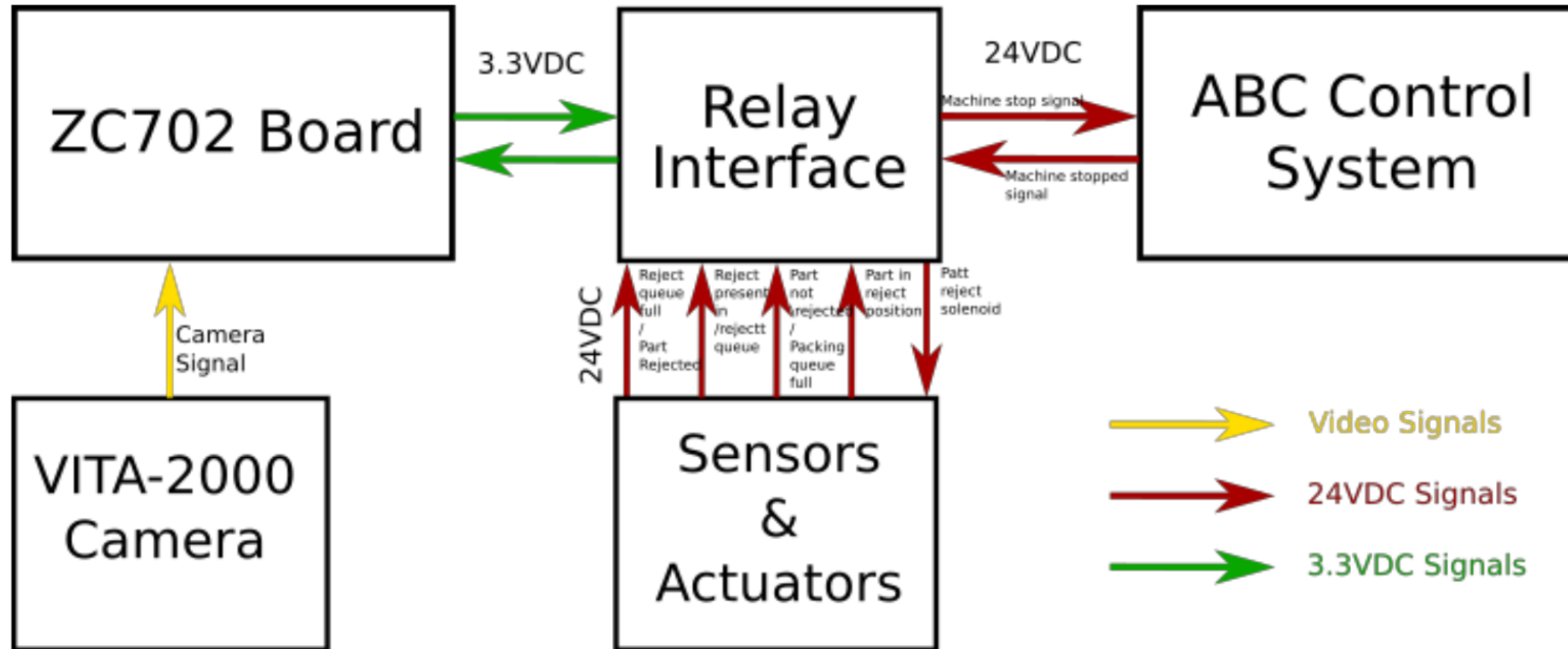
Raspberry Pi4

Keyence industrial
camera.



One solution will be chosen based on their functionality, cost, software/OS availability, sustainability, maintainability, hardware availability, number of modules/subsystems and size. The choice will be made using a 1 to 5 scoring system, with 1 being the lowest and 5 the highest score.

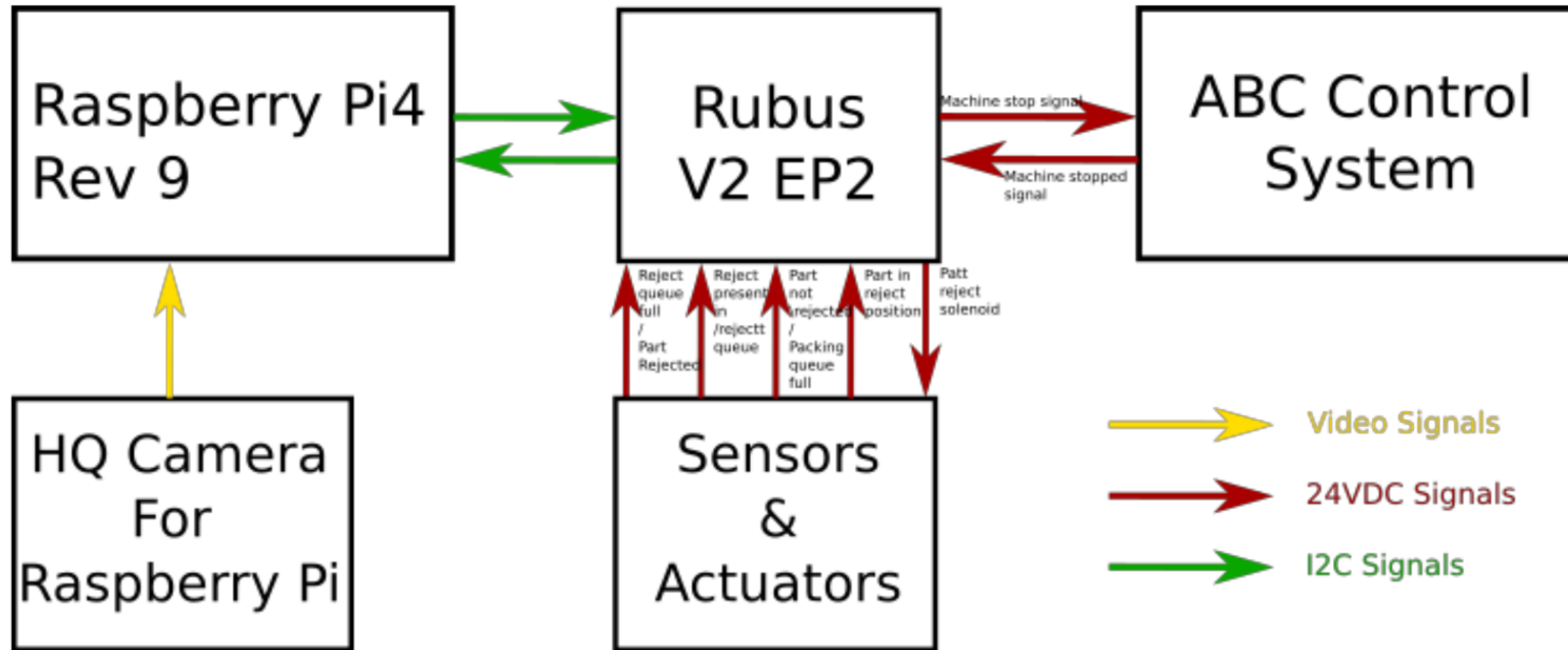
Xilinx Image processing



Xilinx Image processing

	Xilinx	Score
Functionality	HDMI connection Ethernet up to 1000mb/s 1GB ram	3
Total cost (averaged)	£3040	2
Software/OS availability	LabView Software available from National Instruments. The software is currently supported.	4
Sustainability	Compatibility with other software/ hardware not specified by manufacturer	1
Maintainability	Subsystems exchangeable. Recalibration might be required. Restore from a backup might be required	4
Hardware availability	Available directly from Xilinx with 2 weeks lead time.	3
Number of modules/ subsystems	Four: ZC702 board Camera 3,3 to 24VDC interface PSU	2
Size	Not specified by manufacturer	1
Total score		2.5

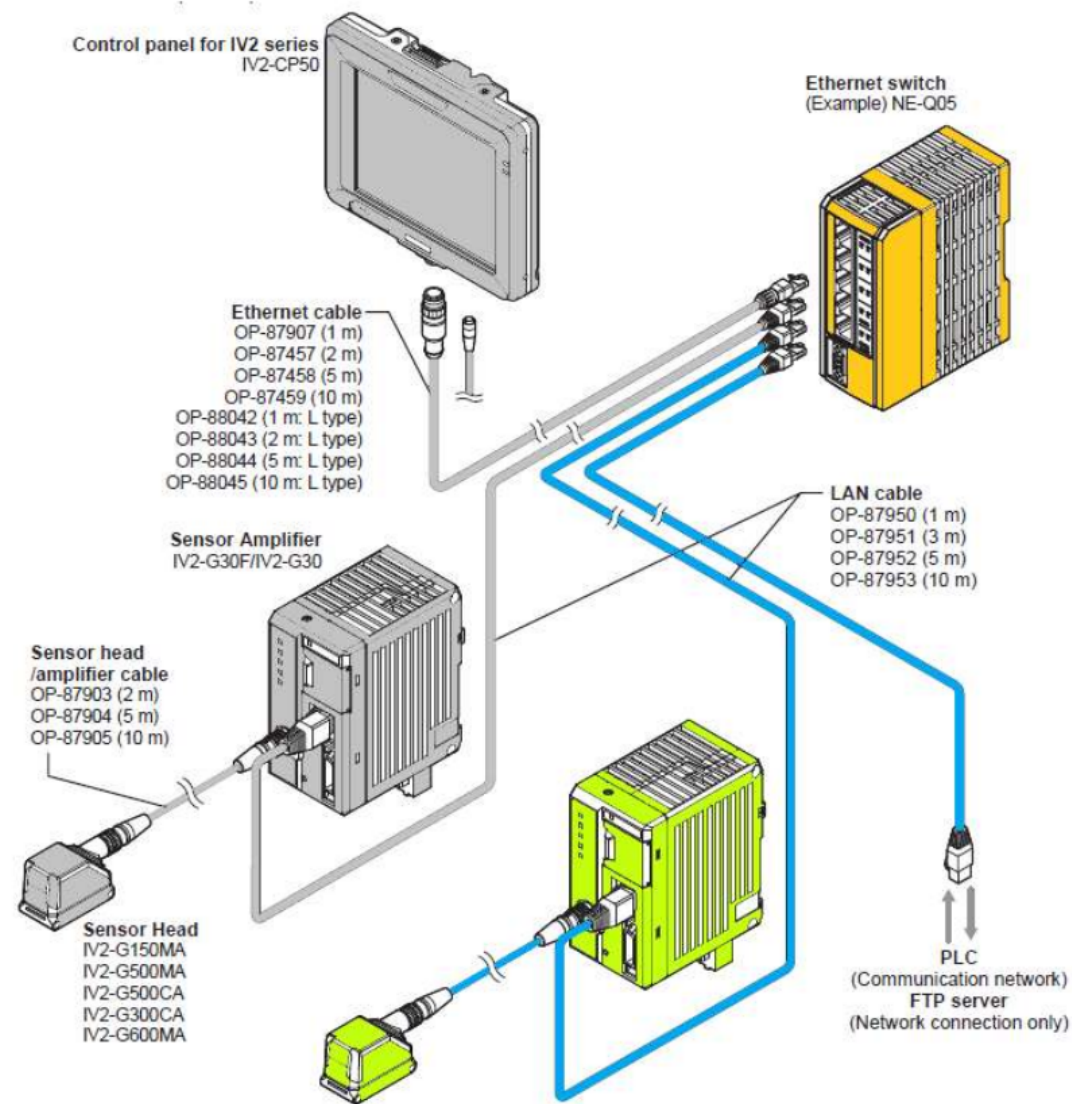
Raspberry Pi4B



Raspberry Pi4B

	Raspberry Pi	Score
Functionality	2x micro-HDMI Wi-Fi Bluetooth Gigabit Ethernet Up to 8Gb ram	4
Total cost (averaged)	£200 (or less depending on availability of production rejects due to cosmetic damage)	5
Software/OS availability	Widely available and regularly updated. Third party and open-source OS available.	5
Sustainability	OS/Programming code backwards and forwards compatible.	5
Maintainability	All subsystems are easily exchangeable and there is no need for reprogramming. All mechanical drawings available for Raspberry Pi 4 board.	5
Hardware availability	Model widely available and will remain in production until at least 2026.	5
Number of modules/ subsystems	Four: Pi board Camera 24VDC interface (I2C) PSU	2
Size	Rubus: Not specified. Pi: 85x56x16 Camera:38x38x18.6 (excluding lens and mount)	3
Total score		4.25

Keyence Industrial Camera



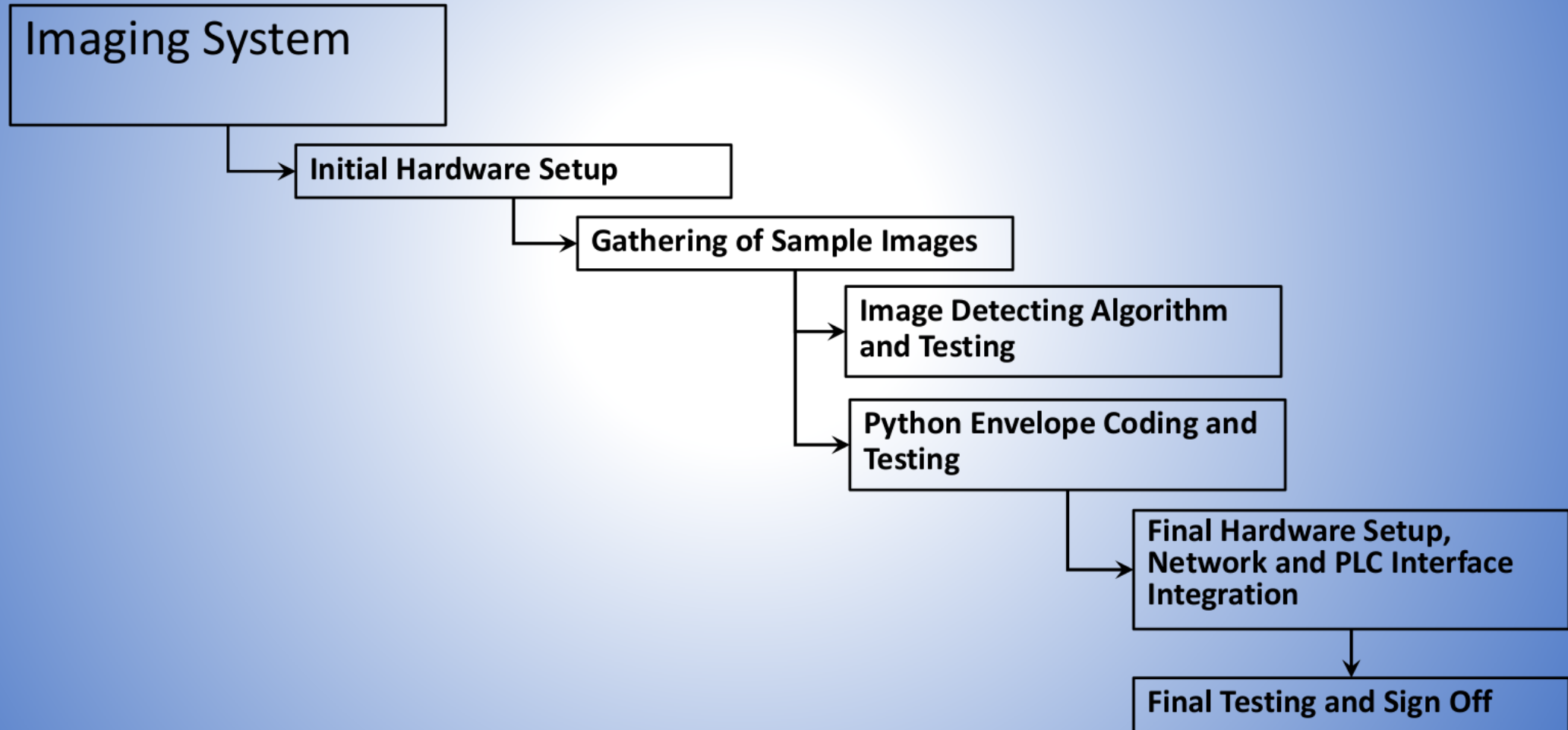
Keyence Industrial Camera

	Keyence	Scores
Functionality	100Base-TX Ethernet IO functions limited to pre-set functions.	2
Total cost (averaged)	£4800	1
Software/OS availability	Discontinued. Last updated November 2020.	1
Sustainability	Compatibility with other software/hardware not specified by manufacturer	1
Maintainability	Subsystems exchangeable. Recalibration might be required. Restore from a backup might be required	4
Hardware availability	Parts of the product are discontinued. Available only from limited suppliers.	2
Number of modules/ subsystems	Two: Camera Sensor amplifier	4
Size	Camera: 46.3x31x24 (excluding cable connection and mount) Sensor Amplifier: 50x95x83.9 (excluding cable connections)	5
Total score		2.5

Solution comparison

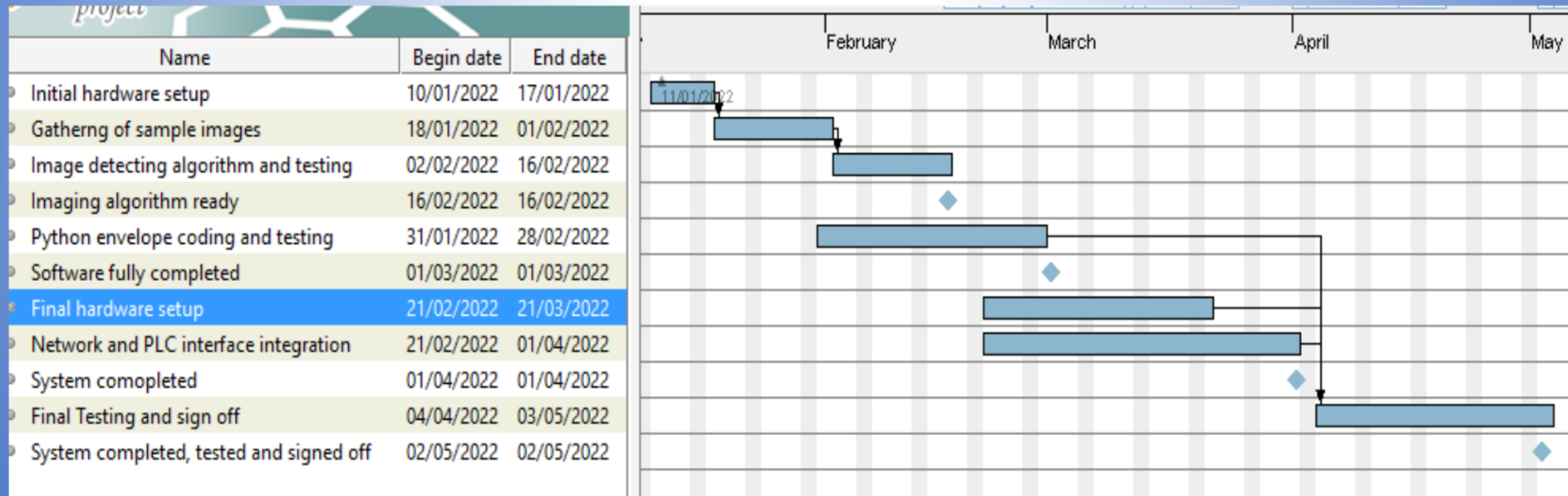
	Xilinx	Raspberry Pi	Keyence
Functionality	- HDMI connection - Ethernet up to 1000mb/s - 1GB ram	2x micro-HDMI Wi-Fi Bluetooth Gigabit Ethernet Up to 8Gb ram	100Base-TX Ethernet IO functions limited to pre-set functions.
Score	3	4	2
Total cost (averaged)	£3040	£200 (or less depending on availability of production rejects due to cosmetic damage)	£4800
Score	2	5	1
Software/OS availability	LabView Software available from National Instruments. The software is currently supported.	Widely available and regularly updated. Third party and open-source OS available.	Discontinued. Last updated November 2020.
Score	4	5	1
Sustainability	Compatibility with other software/ hardware not specified by manufacturer	OS/Programming code backwards and forwards compatible.	Compatibility with other software/hardware not specified by manufacturer
Score	1	5	1
Maintainability	Subsystems exchangeable. Recalibration might be required. Restore from a backup might be required	All subsystems are easily exchangeable and there is no need for reprogramming. All mechanical drawings available for Raspberry Pi 4 board.	Subsystems exchangeable. Recalibration might be required. Restore from a backup might be required
Score	4	5	4
Hardware availability	Available directly from Xilinx with 2 weeks lead time.	Model widely available and will remain in production until at least 2026.	Parts of the product are discontinued. Available only from limited suppliers.
Score	3	5	2
Number of modules/ subsystems	Four: - ZC702 board - Camera - 3,3 to 24VDC interface - PSU	Four: Pi board Camera 24VDC interface (I2C) PSU	Two: Camera Sensor amplifier
Score	2	2	4
Size	Not specified by manufacturer	Rubus: Not specified. Pi: 85x56x16 Camera: 38x38x18.6 (excluding lens and mount)	Camera: 46.3x31x24 (excluding cable connection and mount) Sensor Amplifier: 50x95x83.9 (excluding cable connections)
Score	1	3	5
Total score	2.5	4.25	2.5

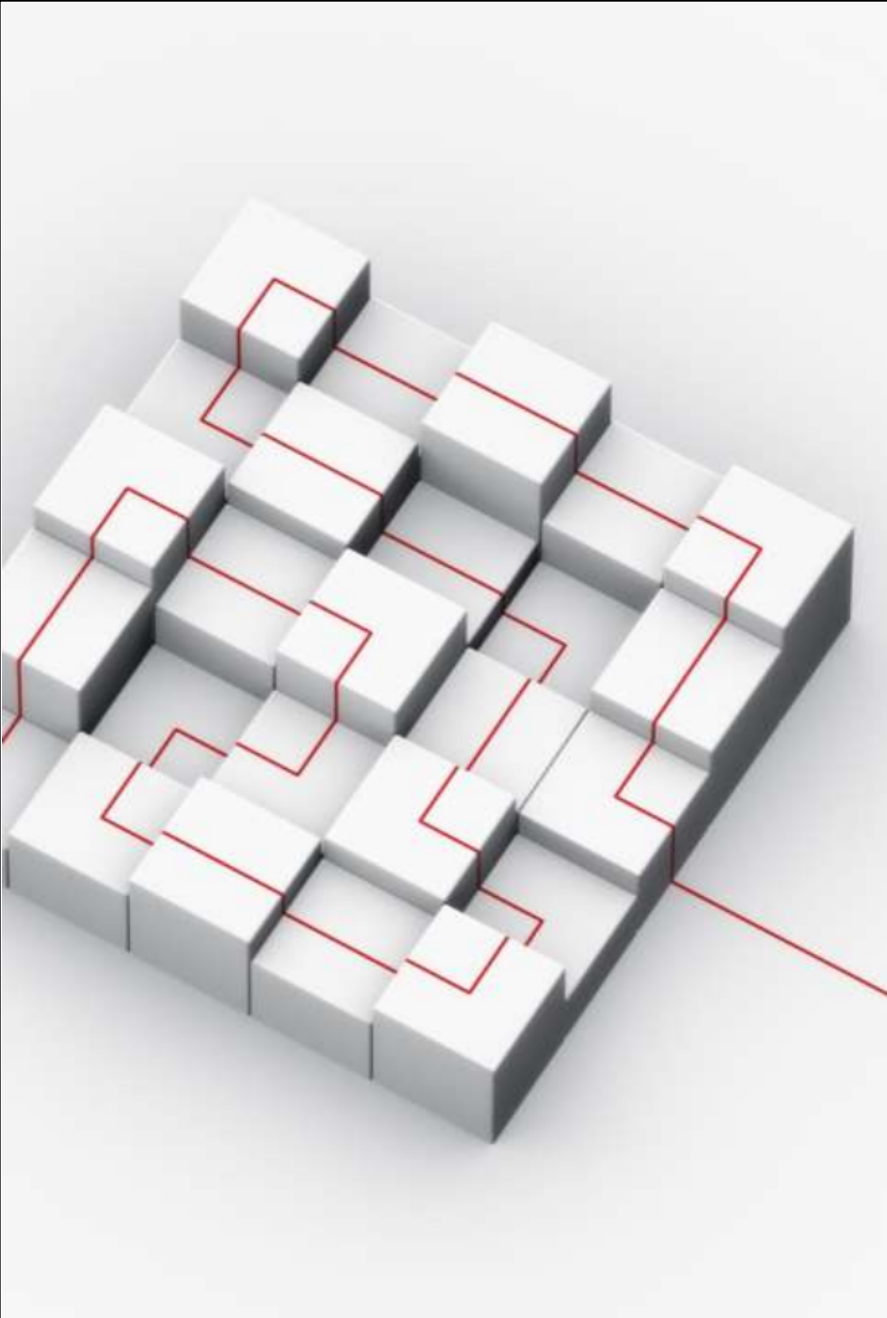
Project Planning, Work Breakdown and Management Techniques



Project Planning, Work Breakdown and Management Techniques

Gantt chart for project planning





Work Done to Date



Part list made and ordered



Started picture gathering process



Initial electrical schematics and block diagrams started



Talks with involved departments and planning out cooperation timelines

A word cloud on a dark blue background. The central element is 'Q&A' in large, white, bold letters. Surrounding it are various question words in different colors (yellow, green, blue, orange) and sizes. The words include: 'What?', 'Where?', 'When?', 'How?', 'Who?', 'Why?', 'What?', 'Where?', 'When?', 'How?', 'Who?', 'Why?', 'What?', 'Where?', 'When?', 'How?', 'Who?', 'Why?'. The words are arranged in a circular pattern around the center, with some words appearing multiple times.

FINAL GRADE

GENERAL COMMENTS

Instructor

51 /100

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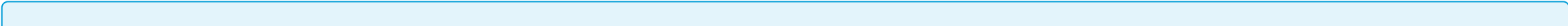
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1. ENGAGEMENT WITH LITERATURE

-  Section 1: Engagement in research, for project background Clear evidence via the explanation. (RD)
Section 5: Engagement in research, for review of solutions Good evidence though there was only time for one solution to be presented. Other solutions were explained in the questioning session that followed. (RD) (6/10)

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2. KNOWLEDGE AND UNDERSTANDING

-  Section 1: Project background Good explanation (RD) Section 3: Project risks, health and safety etc
Some risks considered and explained in the questions(RD) Response to questions 1 and 4 Some good answers but could have been more exact, some was guess work. (RD) (13/20)

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3. COGNITIVE AND INTELLECTUAL

-  Section 1: Problem Definition and constraints Good explanation via the animation (RD) Section 2:
Functional Design Specification Could have been delivered as a table rather than by paragraphs (RD)

18

Section 4: Test planning No evidence presented as presentation over ran the allocated 8 minutes but answered in questions (RD) Response to questions 2 and 6 Good answers (RD) (18/20)

4. PRACTICAL APPLICATION

 Section 5: Critical choice and justification of final solution Not presented due to over run in time but explained in the question session. (RD) Section 6: Project Planning and working breakdown structure Not presented (RD) Response to questions 3 and 5 Good answers (RD) (8/25)

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5. TRANSFERABLE SKILLS

 All sections: Quality of the presentation slides Very good, animation was helpful (RD) All sections: Quality of the delivery style Good style but too slow to achieve in the 8 minutes allocated, presentation was stopped after an over-run of 4 minutes and only one solution had been presented by that time. (RD) (6/10)

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