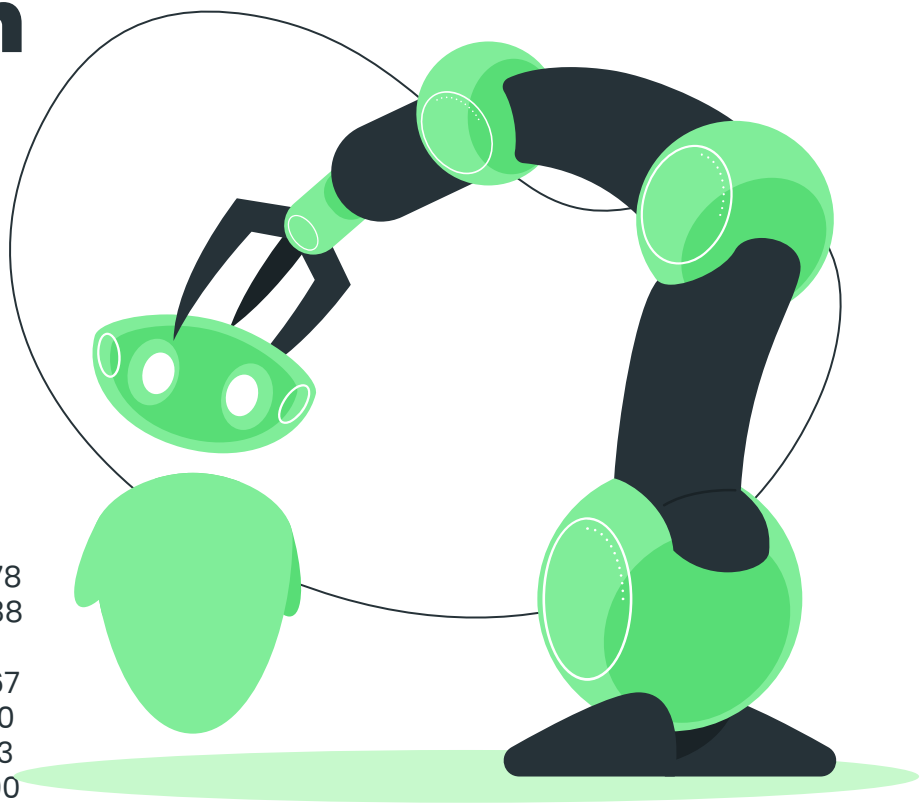
Quality Inspection Cell: Burrs detection TRL2



Mechatronic Design MR3009

P4.

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29/09/2021

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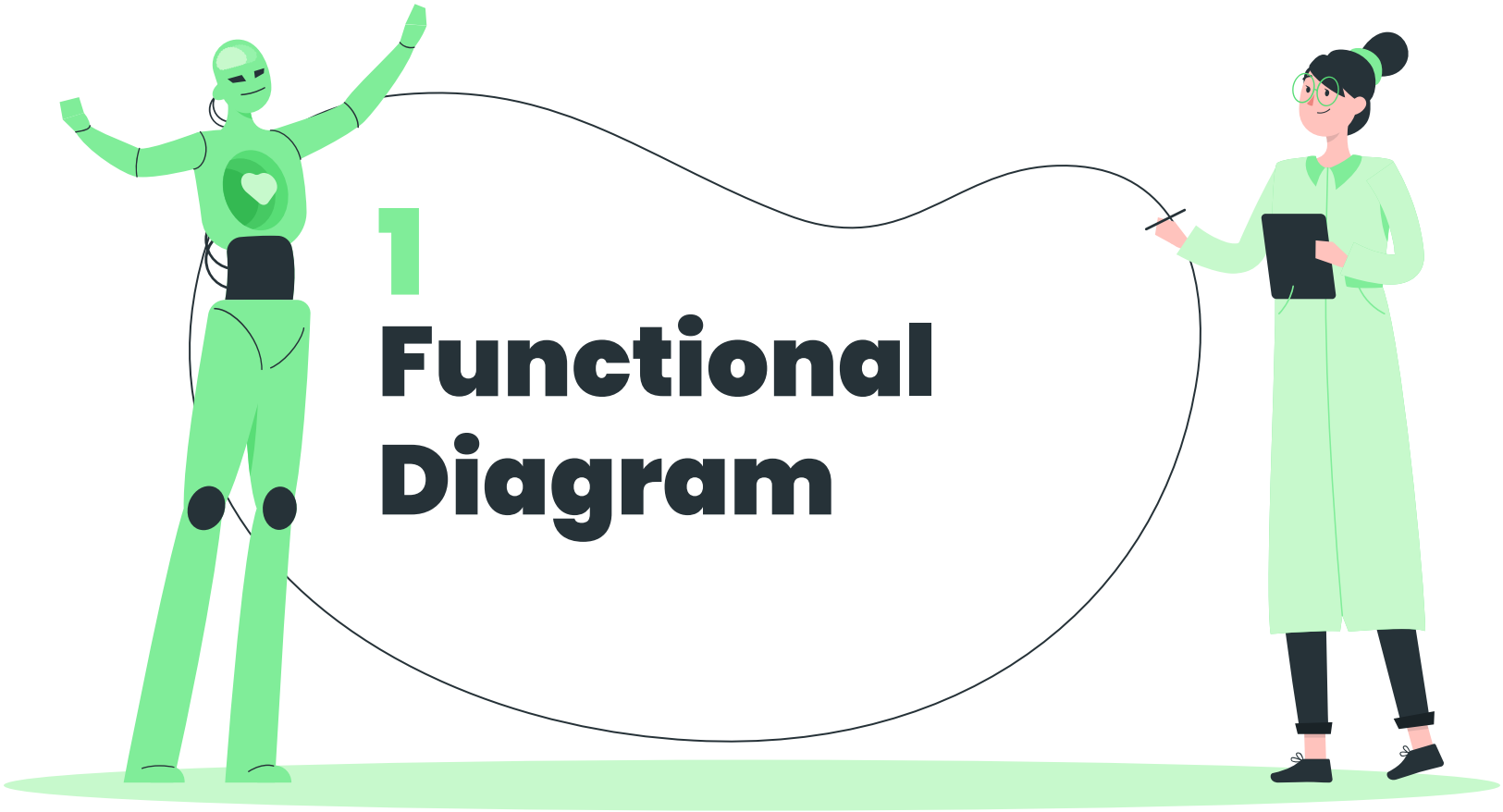
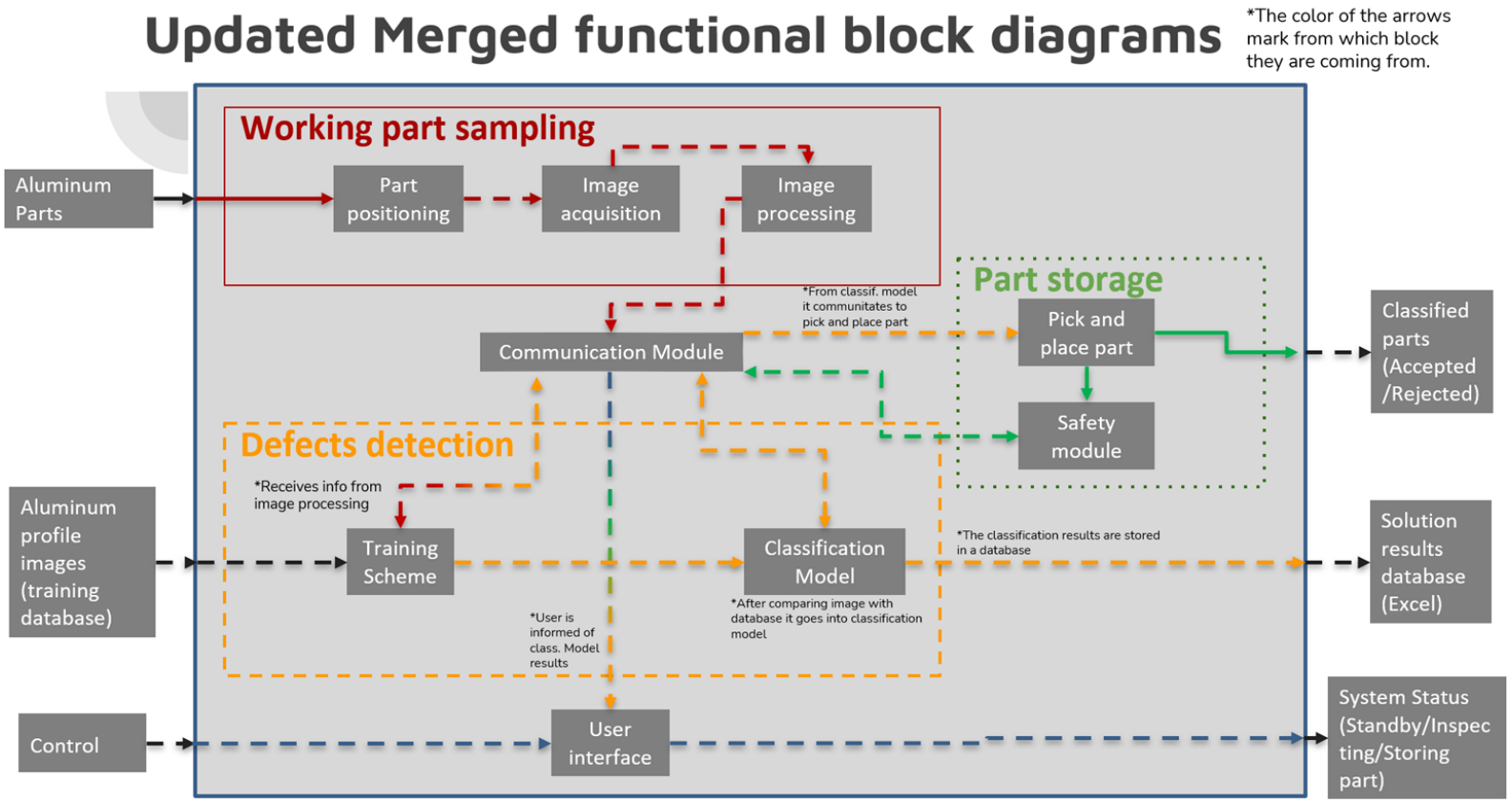


1 Functional Diagram

Functional diagram



2 Morphology Matrix

			Alternatives to Implement Functions			
Functional Modules	Working part sampling	Part positioning	Random location	Specified area of work (Human)	Conveyor	Dispenser of Parts
		Image acquisition: Part Location Image acquisition	Robot holding IP camera	No camera necessary (defined area of work)	IP Roof camera (for area scanning)	-
		Image acquisition: Burr image acquisition	Robot holding IP camera	Specified area for image acquisition with multiples cameras	Fixed camera in workplace with the Robot rotating the part	-
		Image processing	MatLab	Python	Visual Studio	Insight Cognex
	Defects detection	Training scheme	Hold Out Sampling	Cross Validation	-	-
		Classification model (TBD after testing)	Logistic Regression	Support Vector Machine	Neural Network	Random Forest
	Part storage	Pick and place part	Cobot places classified parts in designed bins with mechanical gripper	Conveyor that classifies	Cobot with a vacuum suction gripper	
		Safety module	Wire mesh cage + Cobot collision function	Wire mesh cage + Cobot collision function + tray	Roof camera worker detection + Cobot collision function	Cobot collision function
	Communication module		Computer	Microcontroller (raspberry pi)	-	-
	User interface		LEDs + push button	LCD + push button	Mobile App	HMI Screen (Computer)

Functional Modules			Alternatives to Implement Functions			Low Cost
Working part sampling	Part positioning		Random location	Specified area of work (Human)	Conveyor	Dispenser of Parts
	Image acquisition	Part Location Image acquisition	Robot holding IP camera	No camera necessary (defined area of work)	IP Roof camera (for area scanning)	-
		Burr image acquisition	Robot holding IP camera	Specified area for image acquisition with multiples cameras	Fixed camera in workplace with the Robot rotating the part	-
	Image processing		MatLab	Python	Visual Studio	Insight Cognex
Defects detection	Training scheme		Hold Out Sampling	Cross Validation	-	-
	Classification model (TBD after testing)		Logistic Regression	Support Vector Machine	Neural Network	Random Forest
Part storage	Pick and place part		Cobot places classified parts in designed bins with mechanical gripper	Conveyor that classifies	Cobot with a vacuum suction gripper	
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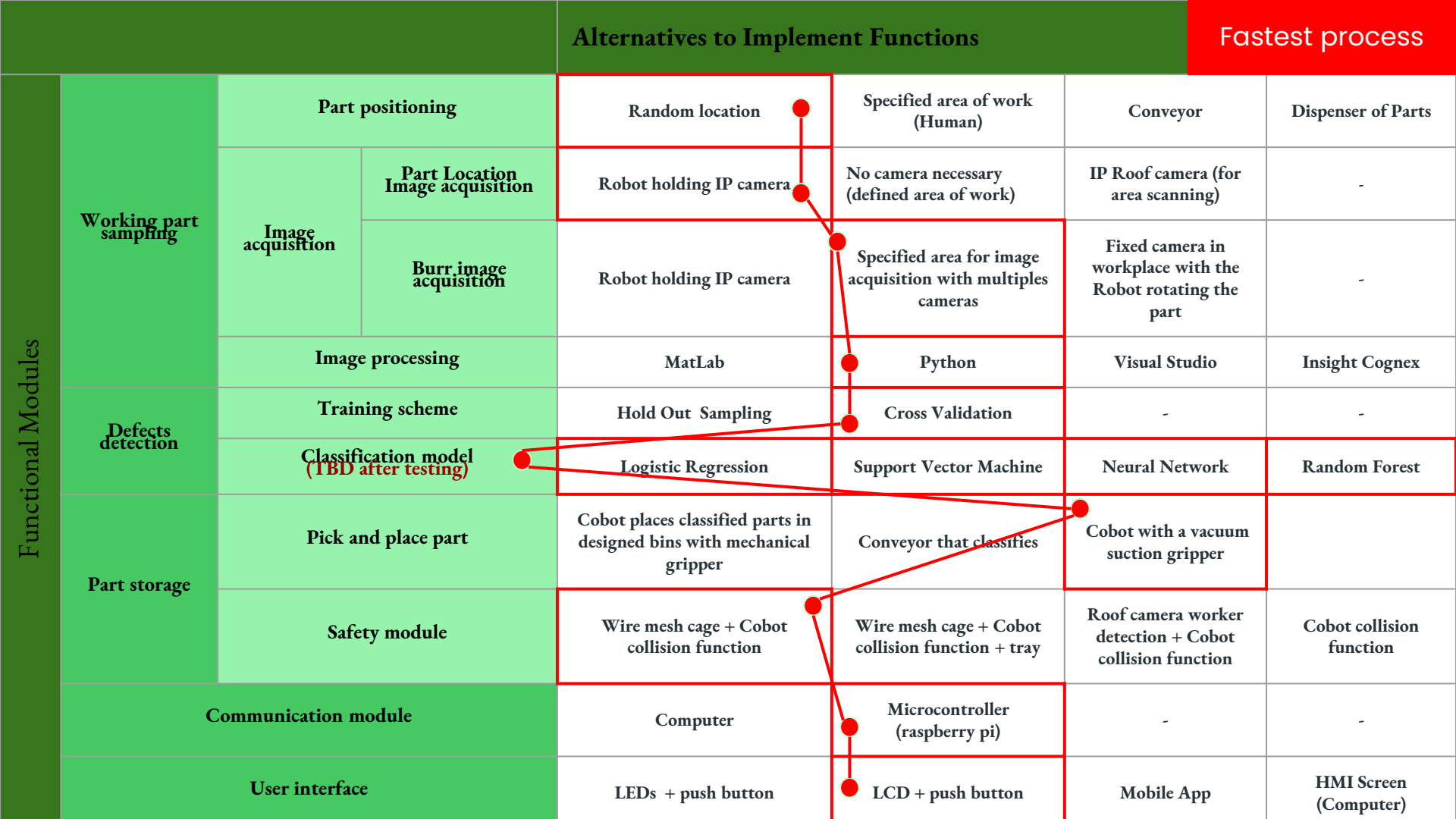
Communication module			Computer	Microcontroller (raspberry pi)	-	-
User interface			LEDs + push button	LCD + push button	Mobile App	HMI Screen (Computer)


Alternatives to Implement Functions
Fastest process
Functional Modules
Working part sampling
Part positioning
Image acquisition
Part Location Image acquisition
Burr image acquisition
Image processing
Defects detection
Training scheme
Classification model (TBD after testing)
Part storage
Pick and place part
Safety module
Communication module
User interface
Random location
Specified area of work (Human)
Conveyor
Dispenser of Parts
Robot holding IP camera
No camera necessary (defined area of work)
IP Roof camera (for area scanning)
-
Robot holding IP camera
Specified area for image acquisition with multiples cameras
Fixed camera in workplace with the Robot rotating the part
-
MatLab
Python
Visual Studio
Insight Cognex
Hold Out Sampling
Cross Validation
-
-
Logistic Regression
Support Vector Machine
Neural Network
Random Forest
Cobot places classified parts in designed bins with mechanical gripper
Conveyor that classifies
Cobot with a vacuum suction gripper
Wire mesh cage + Cobot collision function
Wire mesh cage + Cobot collision function + tray
Roof camera worker detection + Cobot collision function
Cobot collision function
Computer
Microcontroller (raspberry pi)
-
-
LEDs + push button
LCD + push button
Mobile App
HMI Screen (Computer)

Functional Modules				Alternatives to Implement Functions			Most Reliable
	Working part sampling	Part positioning		Random location	Specified area of work (Human)	Conveyor	Dispenser of Parts
		Image acquisition	Part Location Image acquisition	Robot holding IP camera	No camera necessary (defined area of work)	IP Roof camera (for area scanning)	-
			Burr image acquisition	Robot holding IP camera	Specified area for image acquisition with multiples cameras	Fixed camera in workplace with the Robot rotating the part	-
		Image processing		MatLab	Python	Visual Studio	Insight Cognex
	Defects detection	Training scheme		Hold Out Sampling	Cross Validation	-	-
		Classification model (TBD after testing)		Logistic Regression	Support Vector Machine	Neural Network	Random Forest
	Part storage	Pick and place part		Cobot places classified parts in designed bins with mechanical gripper	Conveyor that classifies	Cobot with a vacuum suction gripper	
		Safety module		Wire mesh cage + Cobot collision function	Wire mesh cage + Cobot collision function + tray	Roof camera worker detection + Cobot collision function	Cobot collision function
	Communication module			Computer	Microcontroller (raspberry pi)	-	-
	User interface			LEDs + push button	LCD + push button	Mobile App	HMI Screen (Computer)

			Alternatives to Implement Functions			SAFEST
Functional Modules	Working part sampling	Part positioning	Random location	Specified area of work (Human)	Conveyor	Dispenser of Parts
		Image acquisition: Part Location Image acquisition	Robot holding IP camera	No camera necessary (defined area of work)	IP Roof camera (for area scanning)	-
		Image acquisition: Burr image acquisition	Robot holding IP camera	Specified area for image acquisition with multiples cameras	Fixed camera in workplace with the Robot rotating the part	-
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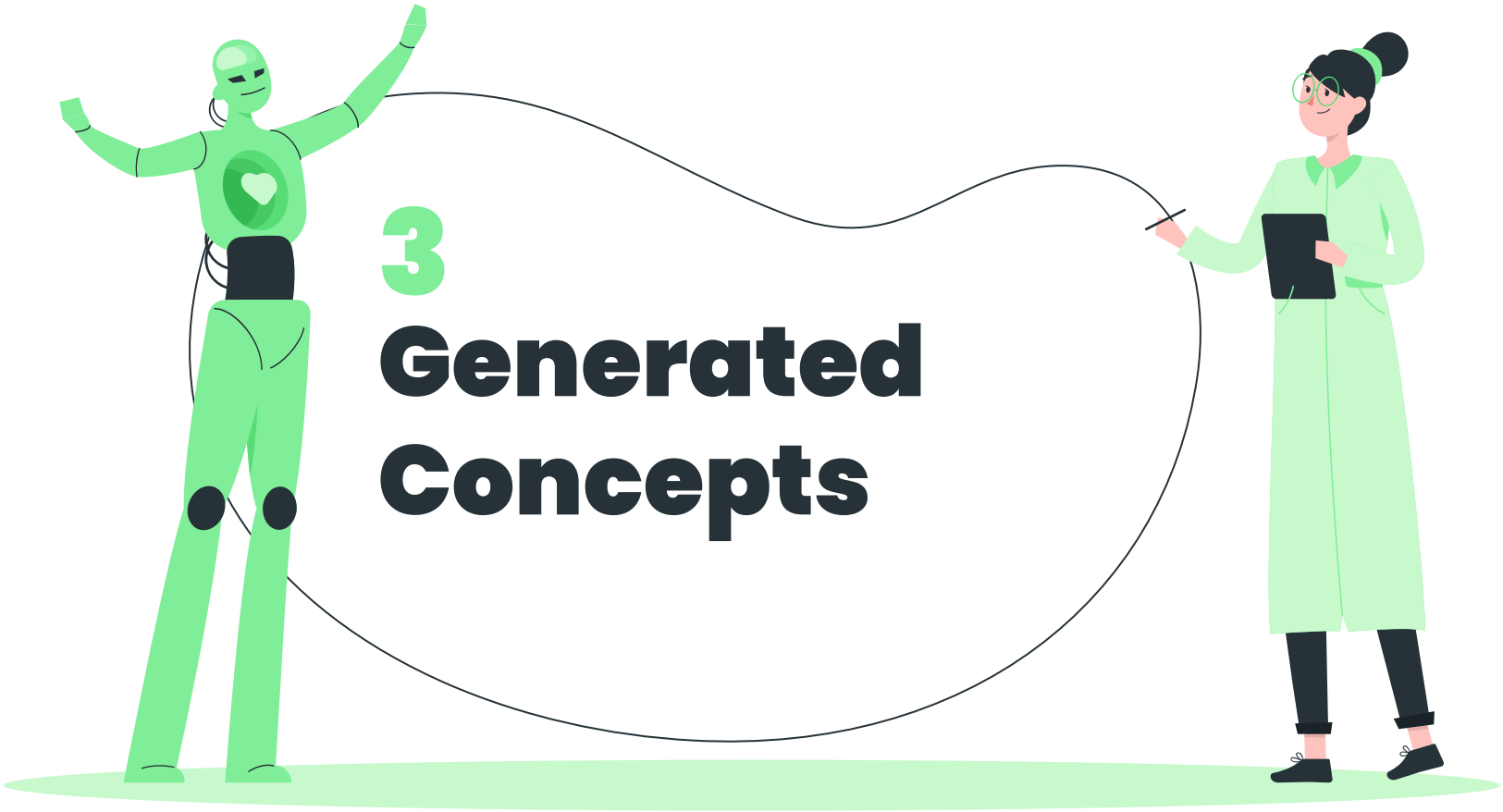
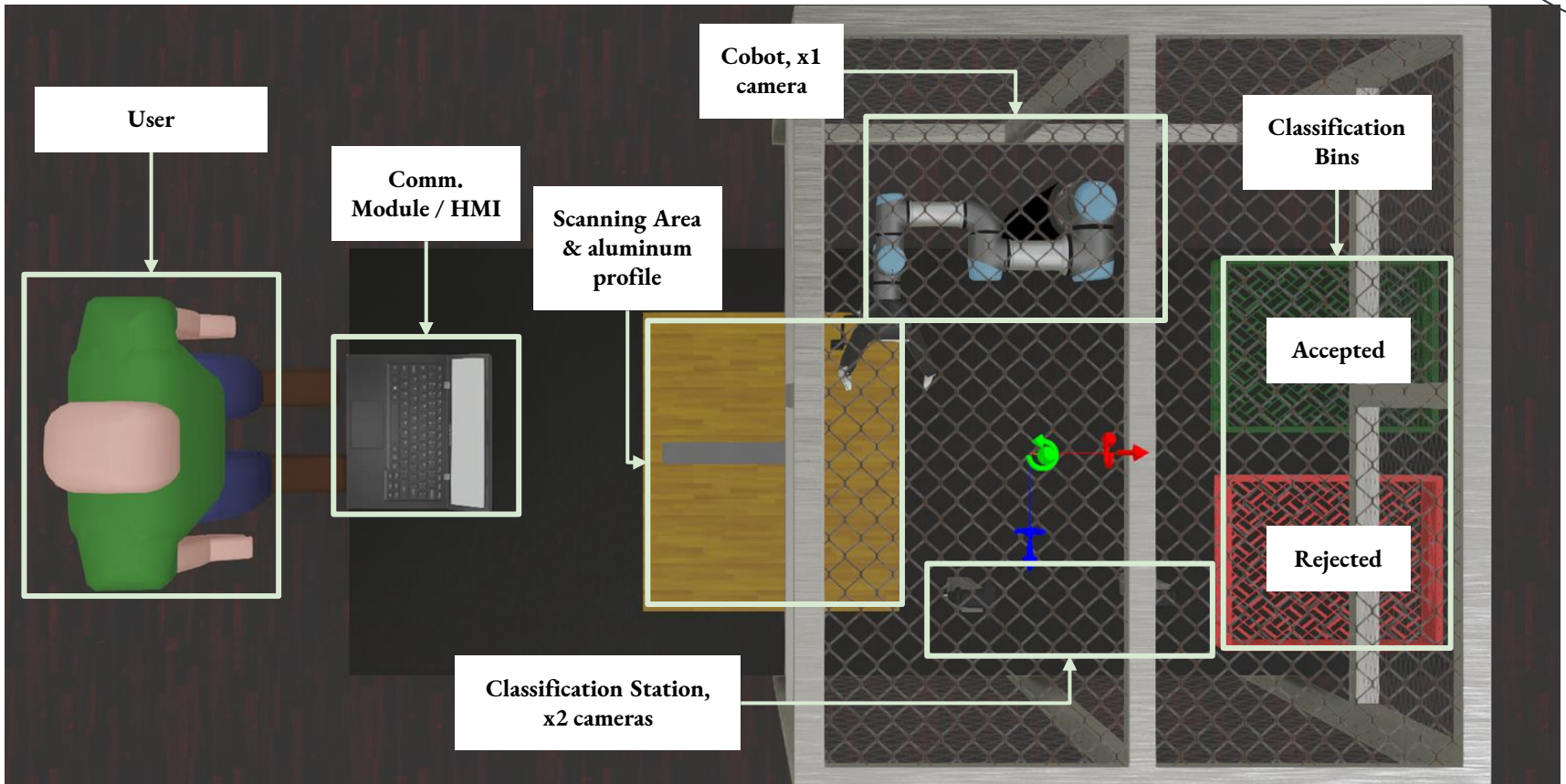
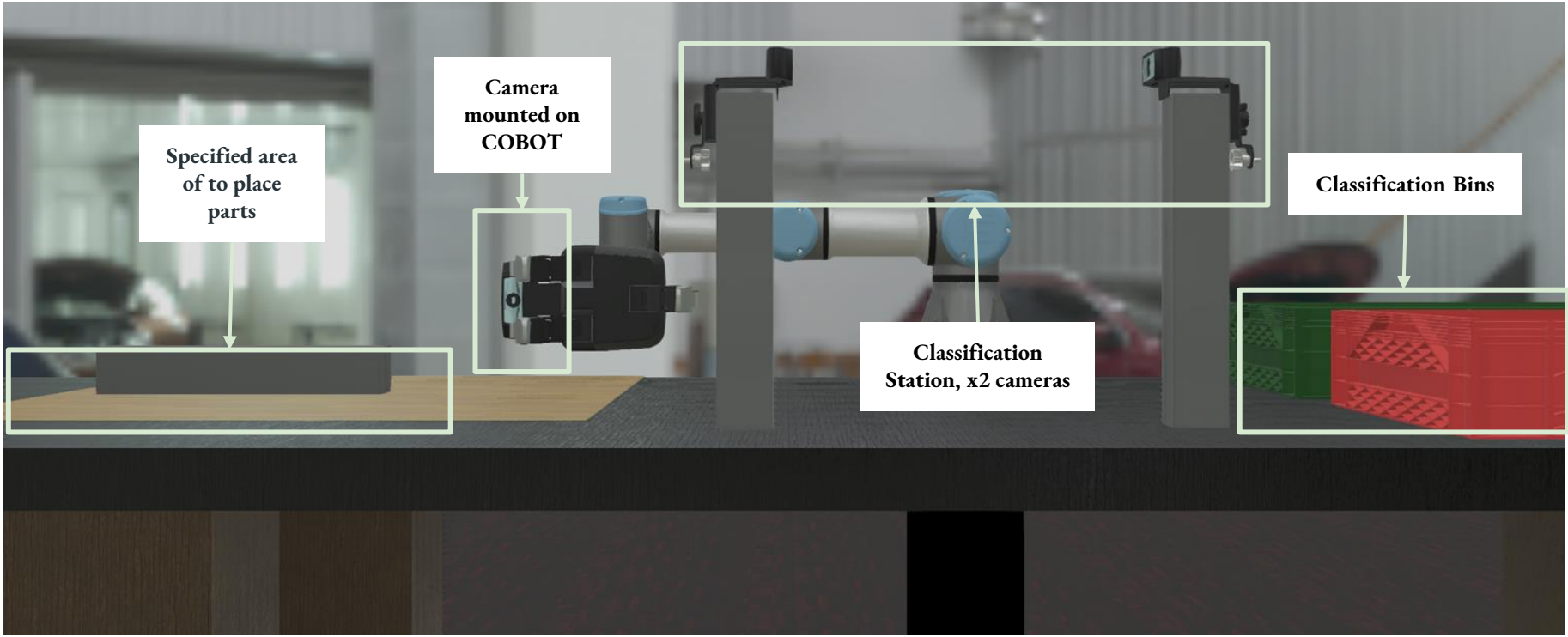

3
Generated
Concepts

Most reliable concept - Top view

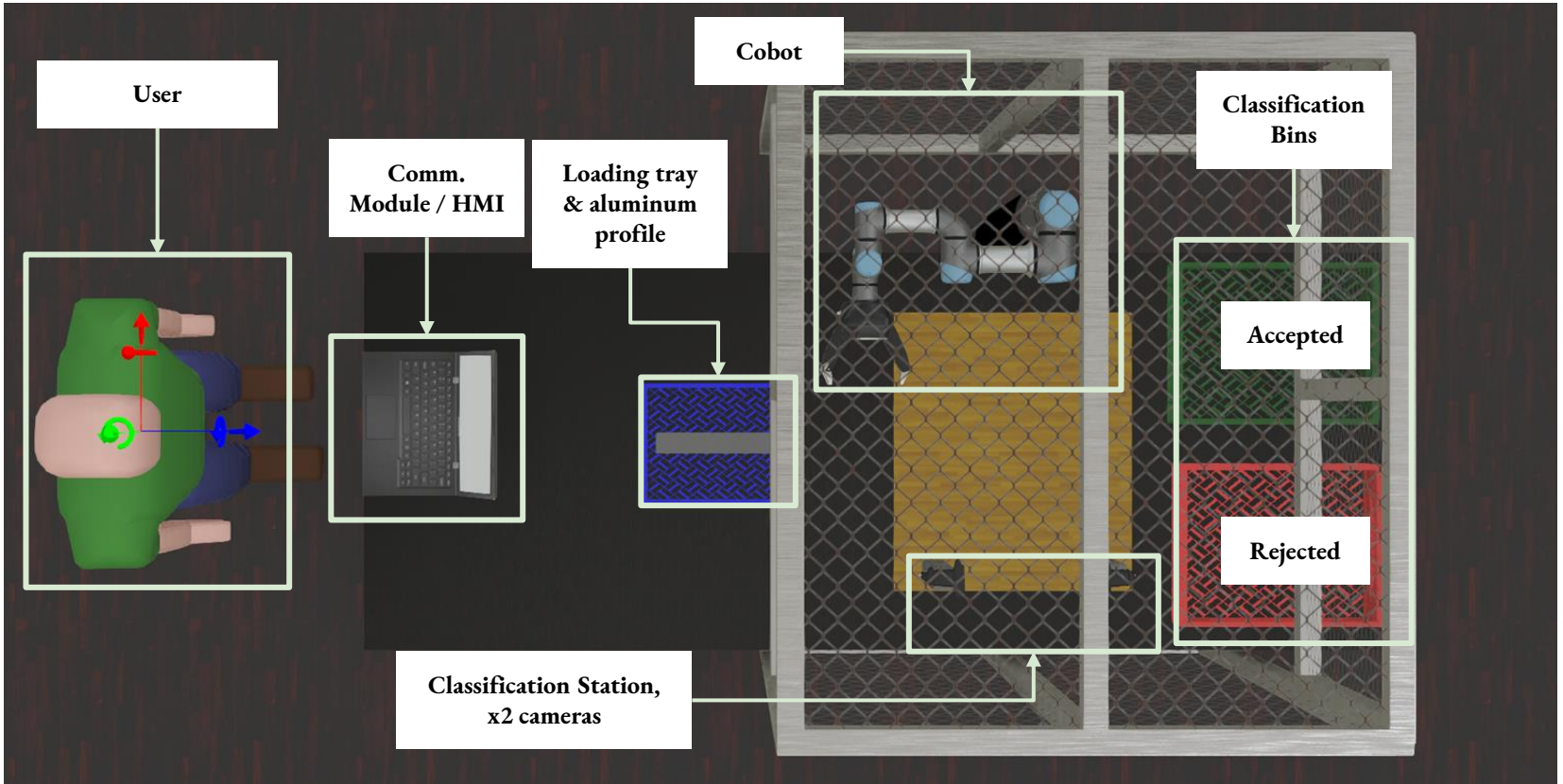


Most Reliable

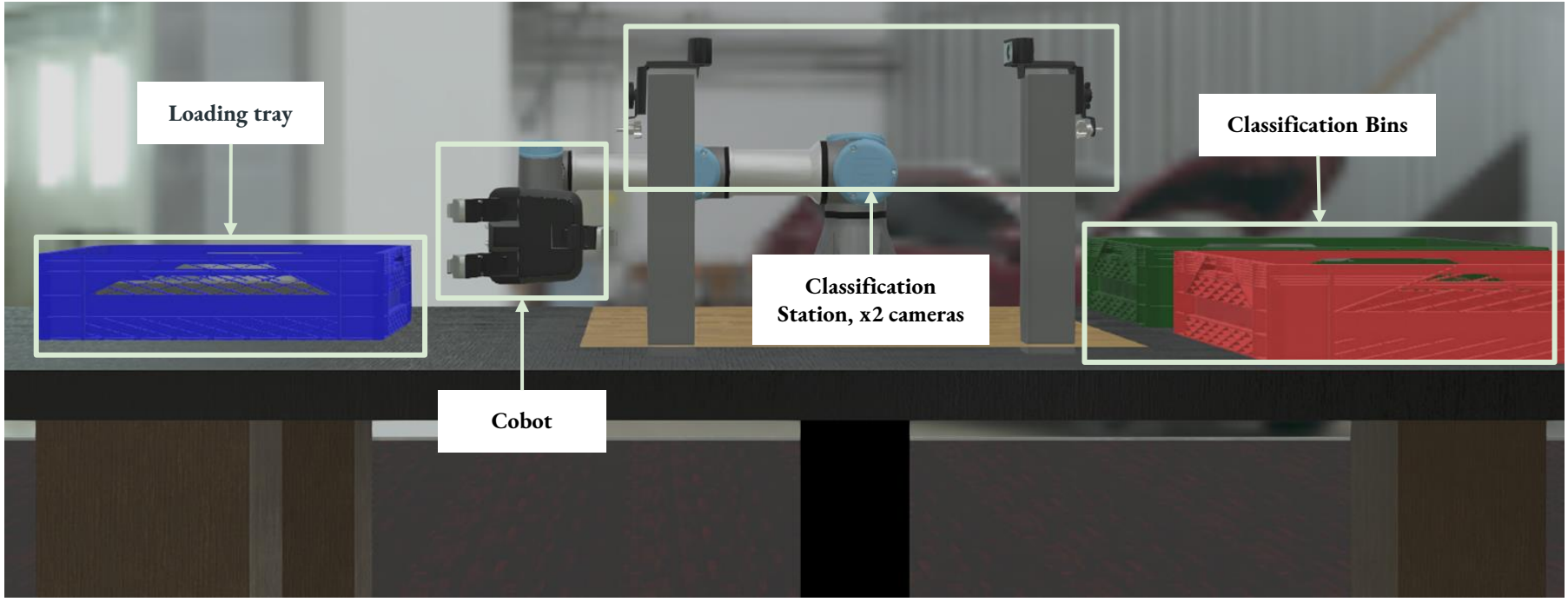
Most reliable concept - close up (w/no cage)



Safest concept - Top view



Safest concept - close up (w/no cage)



4 Selection Criteria

Selection Criteria

Based on the customer values:

- High precision
- Safety
- Low Cost
- Fast Process


5
Selected
Concepts

Pugh Matrix

Less than spec 0
Sames as spec 1
More than spec 1.1

Weight	Customer Value	Low Cost	Fastest Process	Most reliable	Safest
0.35	1. High Precision	0	1	1.1	1.1
0.35	1. Safety	0	1	1	1.1
0.2	2. Low cost	1.1	0	0	0
0.1	3. Fast process	0	1.1	1	1
1	**Total Score**	27.5%	77.5%	77.5%	80%
	Weighted total Score	22.0%	81%	83.5%	87%