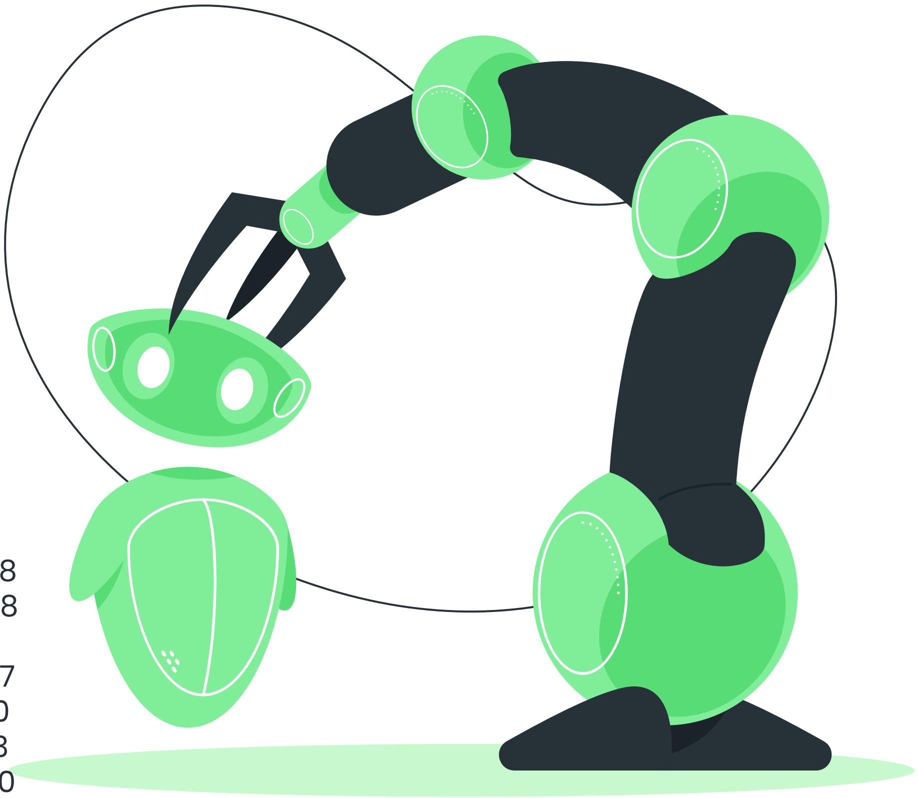
Quality Inspection Cell: Burrs detection



Mechatronic Design MR3009

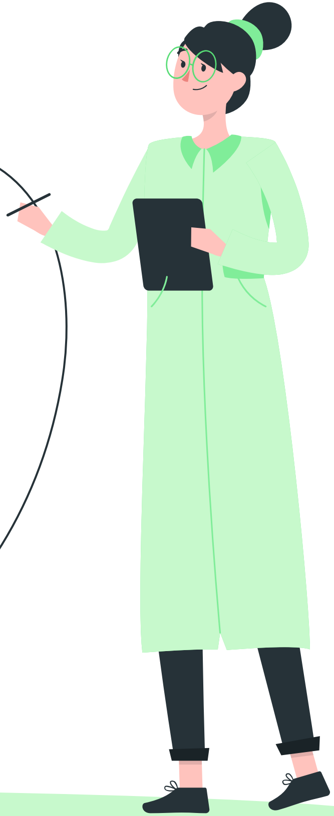
P4.
José Angel Soto Hernández A01039978
Nathalie Vilchis Lagunes A01364838
Hector Everardo Martínez Cisneros A01282300
Teclo Moreno Rodriguez A01252067
Estefany Morales Valdes A01281880
Diego A. Santisteban Pozas A01154423
Jose Antonio Arrambide Garza A00817790

03/11/2021

Table of Contents

1

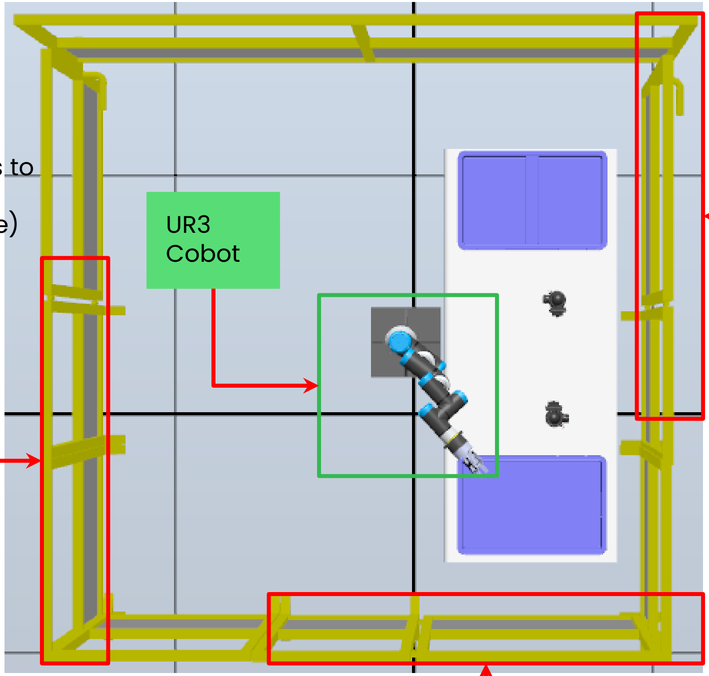
Detailed designs of selected concept



Quality Station (RobotStudio)

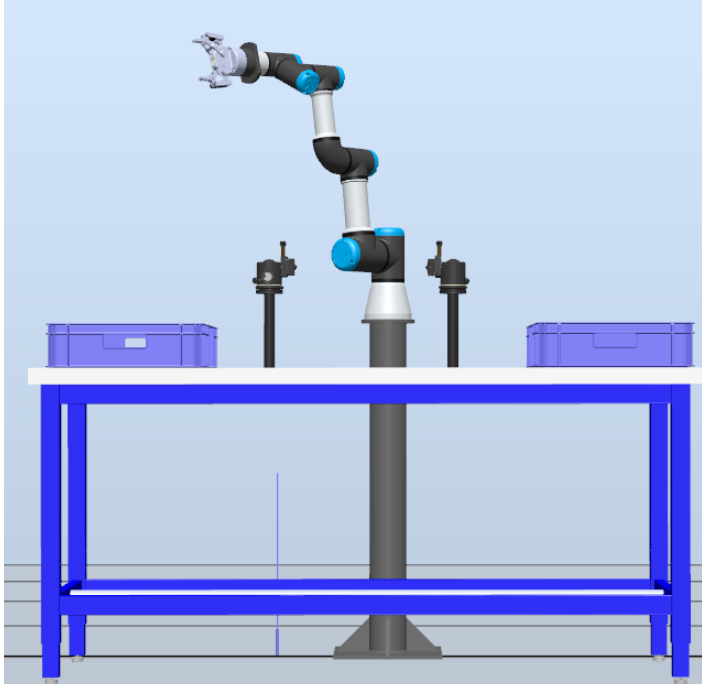
Door 3: Extraction of separated aluminum profiles

Door 1: Access to cobot (maintenance)



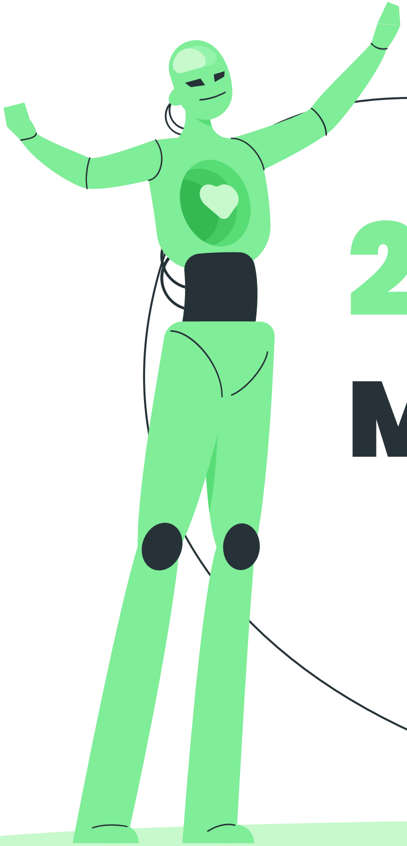
Door 2: Loading of aluminum profiles

*The UR3 Cobot will be rec



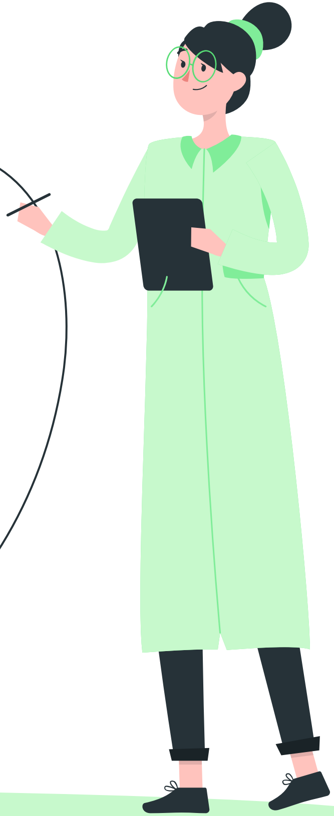
Operation

1. User loads the drilled aluminum profiles in a designated area and close the station door
2. User commands cobot to pick the aluminum profiles when ready.
3. The cobot moves the profile between the two ip cameras.
    a. The cobot slightly rotate profiles (For angular pictures)
4. The pictures will be send to python/orange trainer
5. Trainer communicates the classification results to cobot through python.
6. Cobot separates profiles according to results
7. User may extract classified profiles

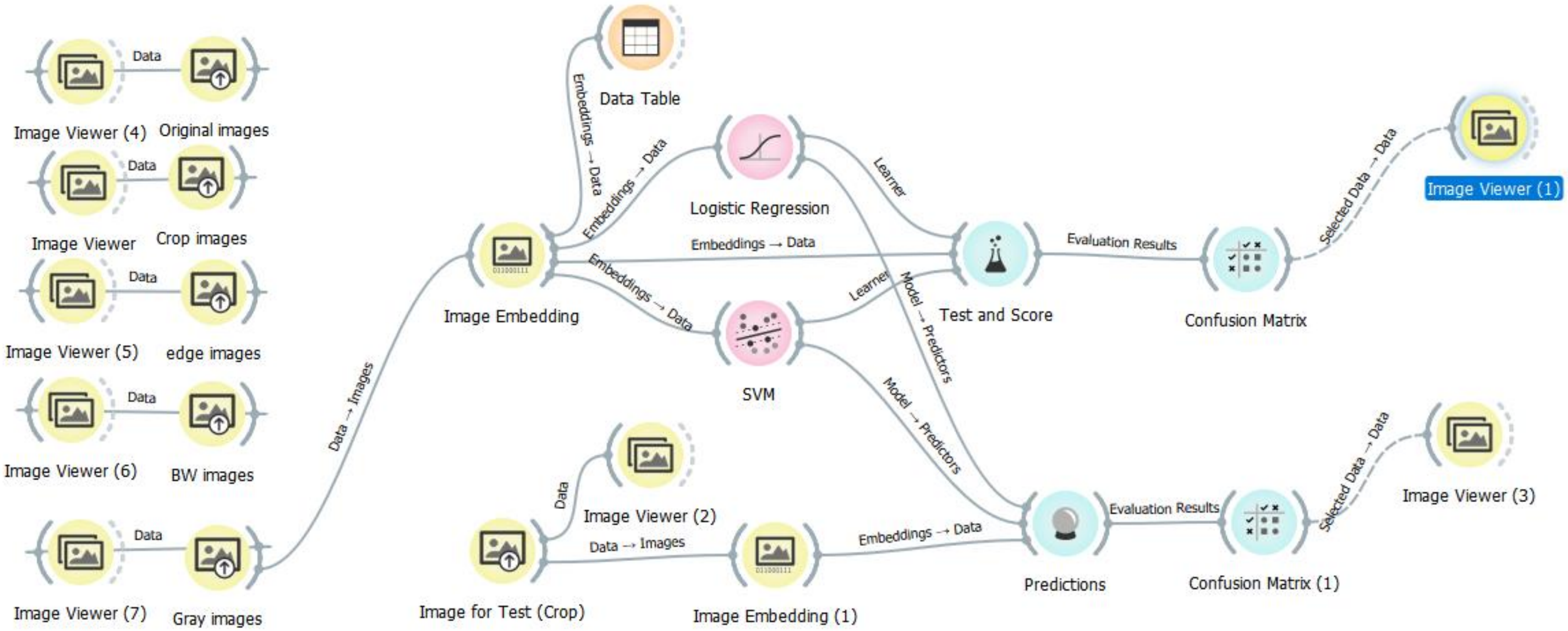


2

Models

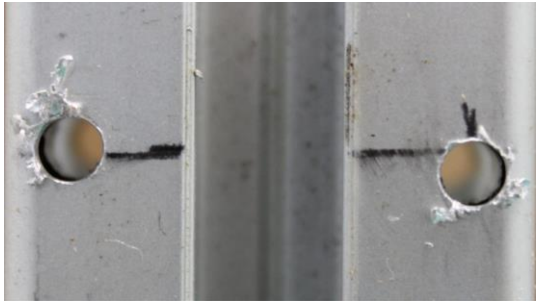


Classification training (Orange)



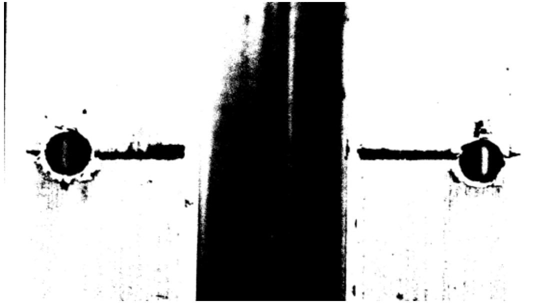
Filters

Front-Original

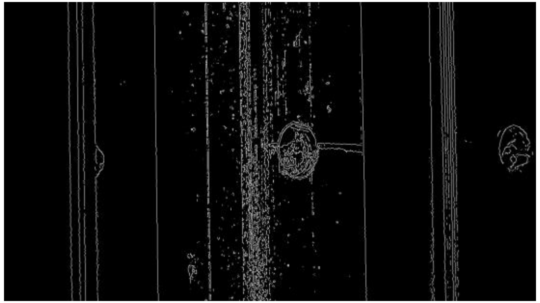


Angled-Grayscale

Frontal-Binary



Angled-Edge



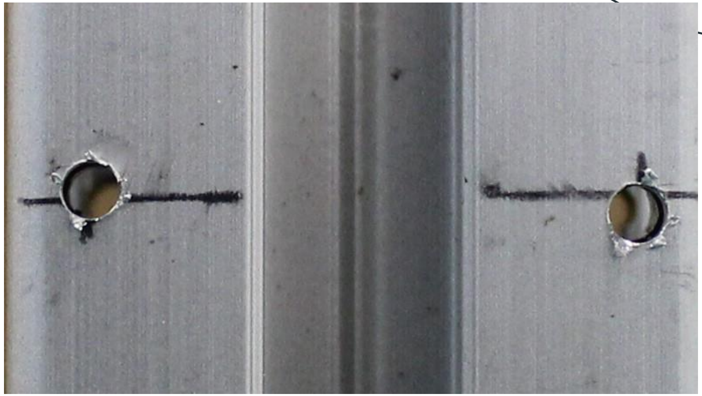
First Test

Datasets

- Original
- Gray
- Edge
- Binary

Best Model :

87.5% accuracy

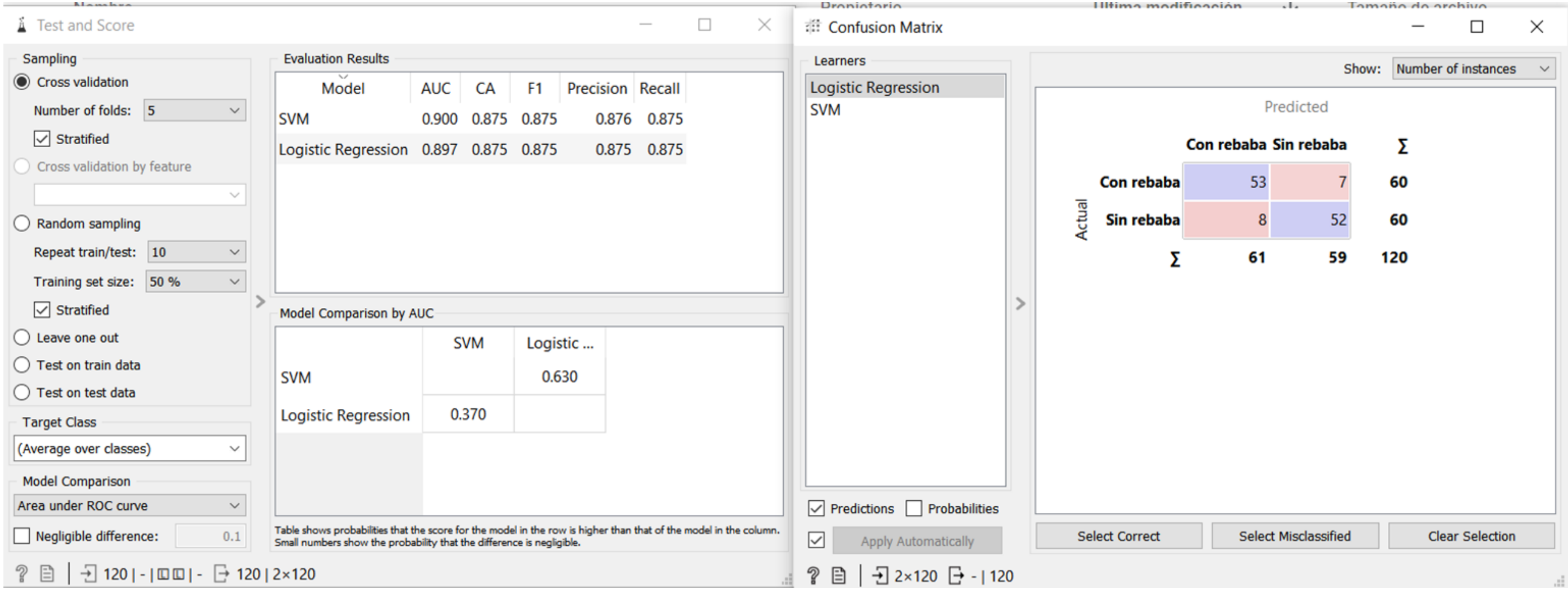


Conclusions

- Cropped images work better than originals
- The best results are with grayscale images
- Front images work noticeably better than angled ones
- Cross Validation with 5 divisions is the best performing sample type

Best Model from 1st Test 87.5 % accuracy

★ Logistic regression and SVM with Cross Validation (V3)



Model	AUC	CA	F1	Precision	Recall
SVM	0.900	0.875	0.875	0.876	0.875
Logistic Regression	0.897	0.875	0.875	0.875	0.875

	SVM	Logistic ...
SVM		0.630
Logistic Regression	0.370	

Actual \ Predicted	Con rebaba	Sin rebaba	Σ
Con rebaba	53	7	60
Sin rebaba	8	52	60
Σ	61	59	120

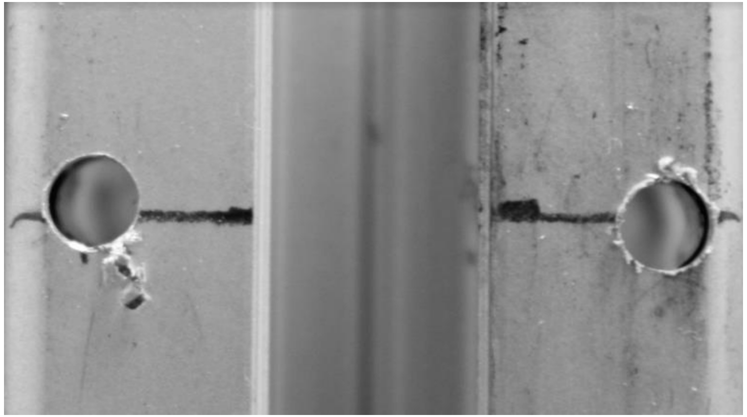
2nd Test

Datasets

Frontal crop images in grayscale

Best Model :

92.9% accuray

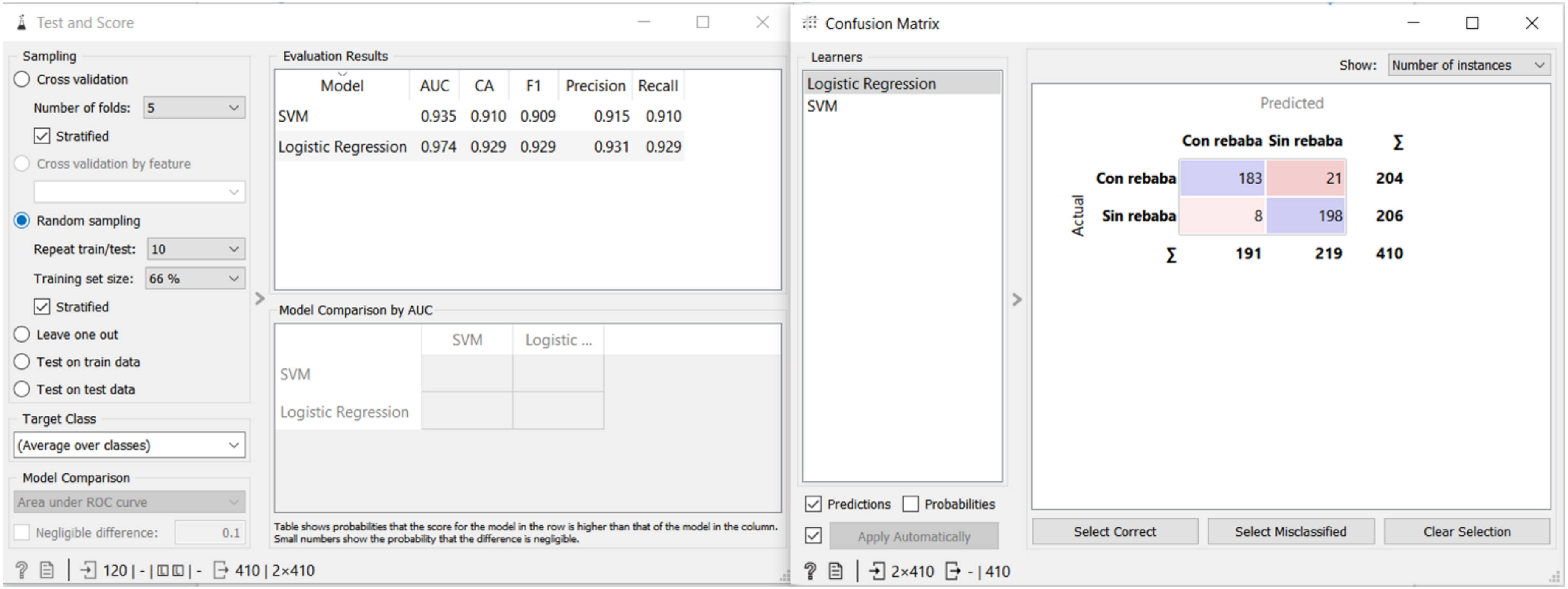


Parameters to vary:

- ❑ Embedder
- ❑ Sampling method
- ❑ Logistic Regression Strength
- ❑ Logistic Regression Regularization Type
- ❑ SVM type
- ❑ SVM Kernel

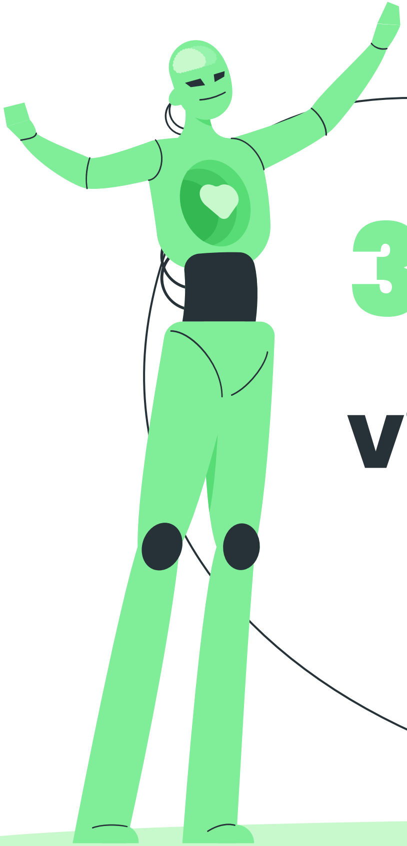
Best Model from 2nd Test : 92.9 % accuracy

★ Logistic Regression with Random Sampling（VGG19)



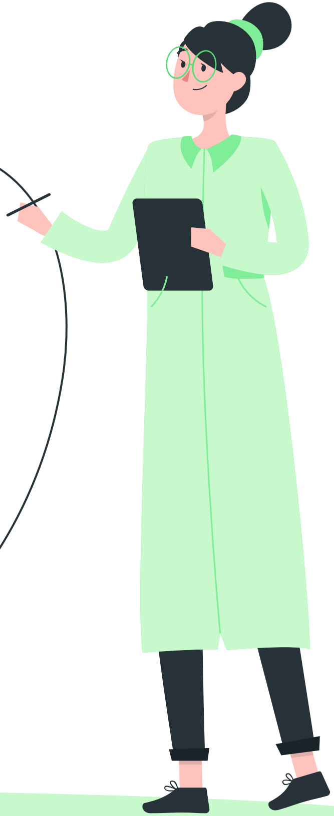
Model	AUC	CA	F1	Precision	Recall
SVM	0.935	0.910	0.909	0.915	0.910
Logistic Regression	0.974	0.929	0.929	0.931	0.929

	Con rebaba	Sin rebaba	Σ
Con rebaba	183	21	204
Sin rebaba	8	198	206
Σ	191	219	410

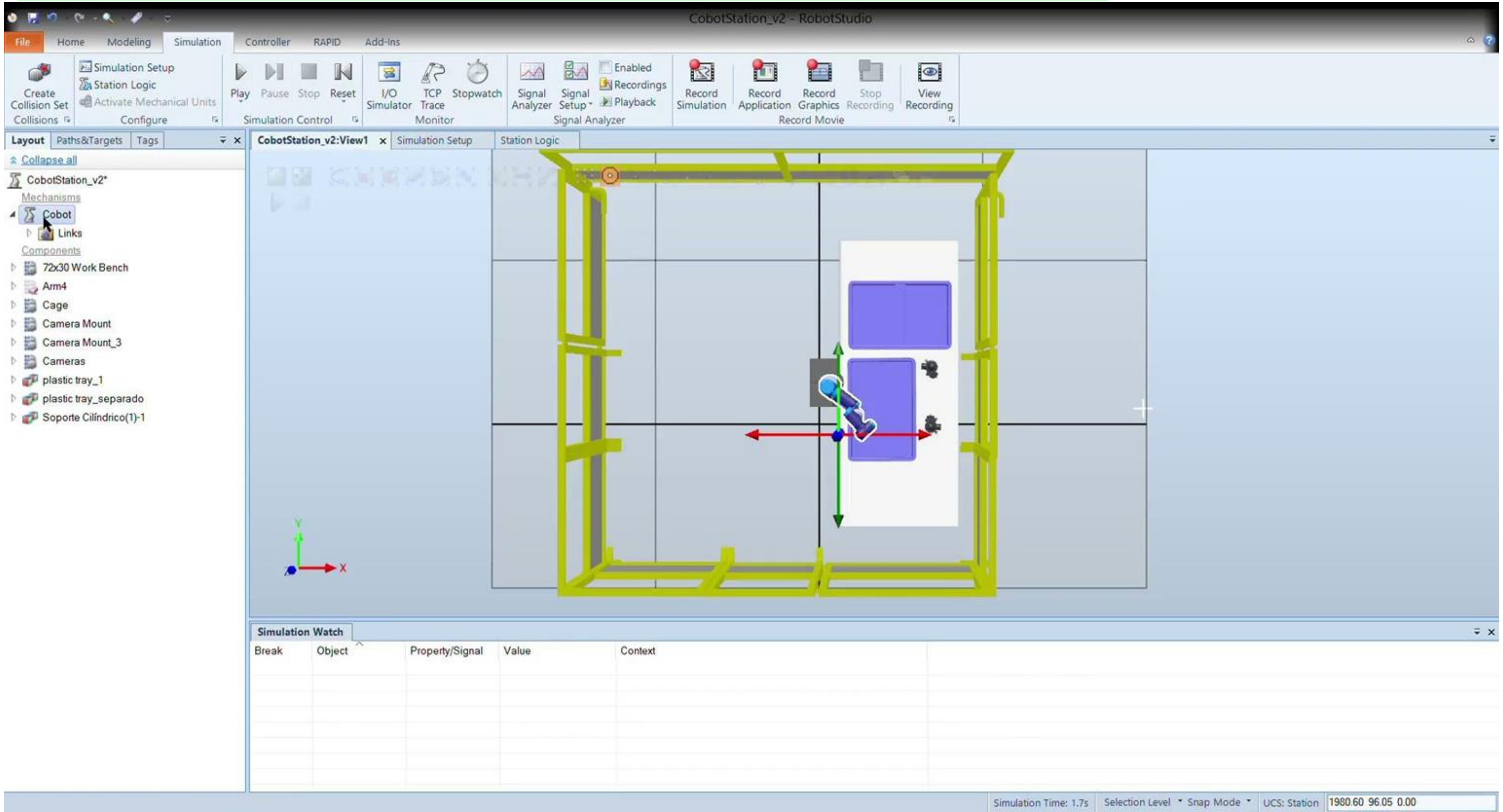


3

Virtual Prototypes



RobotStudio



Python & Orange

- Module for Python Script in Orange
- Library of Orange for Python
- Classification models can be generated directly in Python

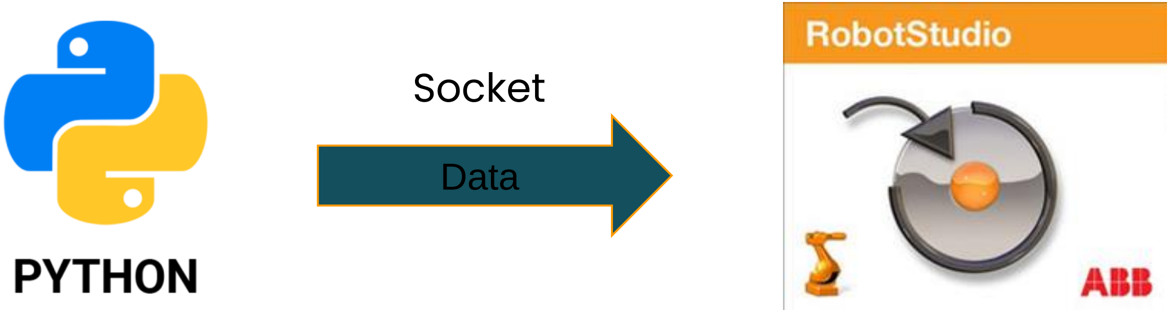
PYTHON

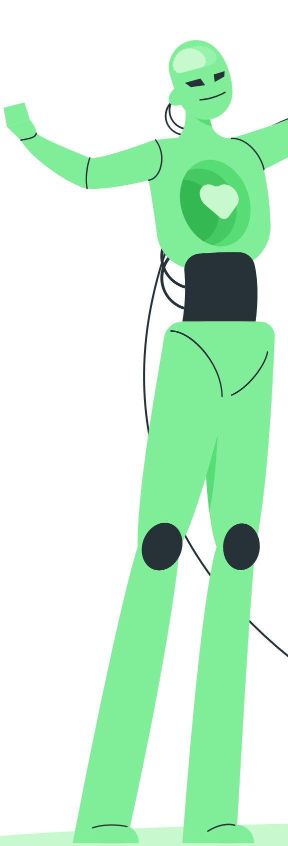
orange

DATA MINING
FRUITFUL&FUN

RobotStudio & Python Communication

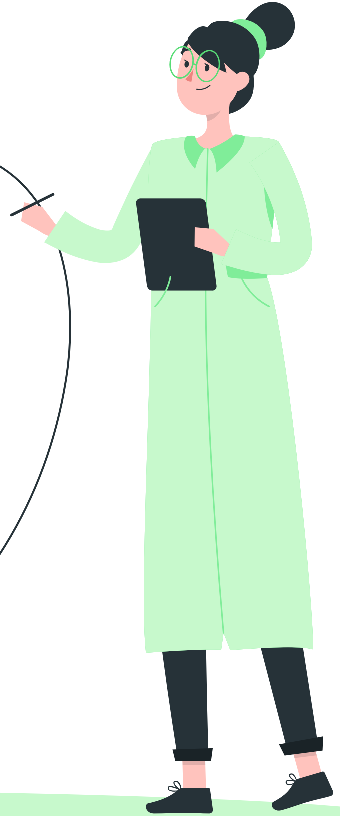
- Python needs to send the variable of accepted or rejected to RobotStudio
- Communication will be established through TCP/IP protocol (sockets)
- The client will be Python and server will be the server.





4

Plan for final prototype

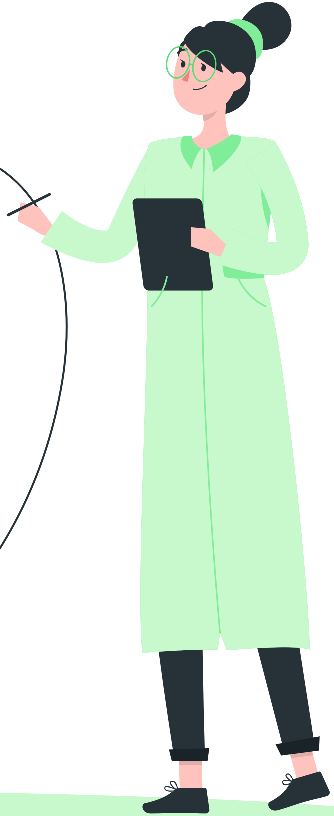


Plan for Final Prototype

- Integrate all the programs with real data exchange to simulate as close to reality as possible.
- Adjust the models, designs and approaches to ensure reaching the requirements of the client such as: Time, Quality, Reliability, Safetiness.
- Run enough tests in order to generate the specifications and recommendations of the final product.

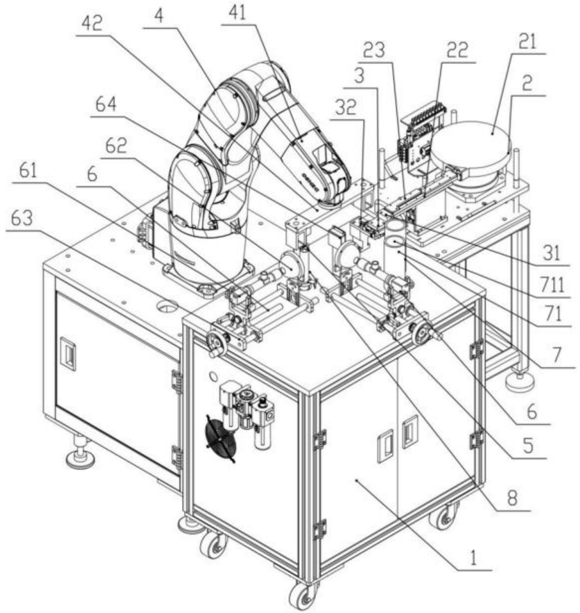
5

Freedom to Operate



360 degrees product burrs detection device of rotation type

- Applicant: Dongguan Shengxiang Precision Metal Co Ltd
- Application date: 2018-05-29
- Publication date: 2018-12-11

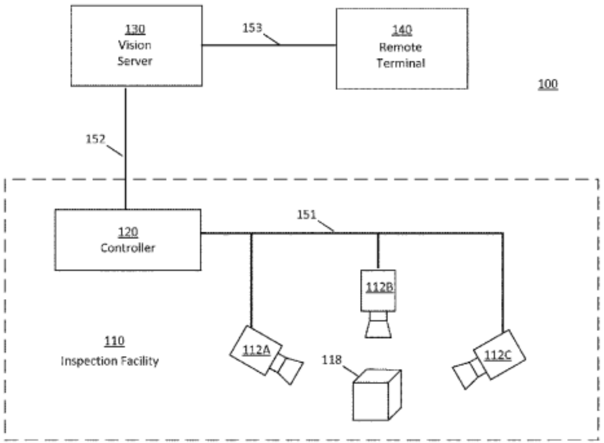


Extracted from:
https://patents.google.com/patent/CN108982509B/en?q=burrs+detection&oq=burr

Other patents...

Machine-vision system and method for remote quality inspection of a product

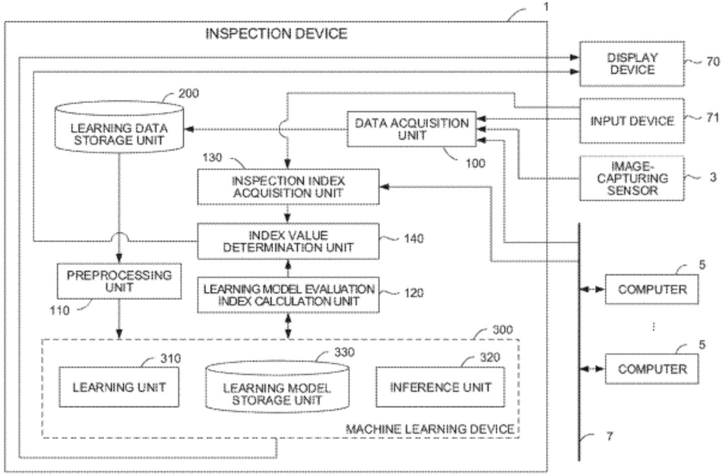
- Applicant: SIGHT MACHINE Inc
- Application date: 2018-04-10
- Publication date: 2019-03-21



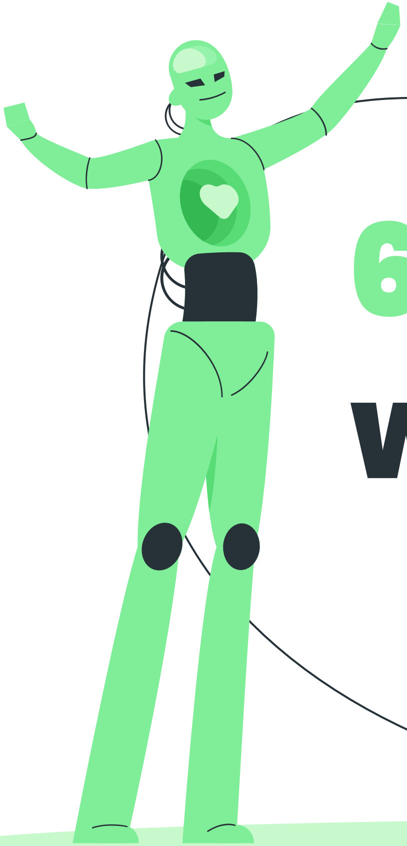
Extracted from:
https://patents.google.com/patent/US20200082225A1/en?q=(computer+vision+manufacturing+quality+control)&language=ENGLISH&oq=(computer+vision+manufacturing+quality+control)+language:ENGLISH&page=1

Inspection device and machine learning method- Analyzer

- Applicant: Keisuke Watanabe, Yasuhiro Shibasaki
- Application date: 2018-09-12 (JP) & 2019-09-12 (DE-US-CN)
- Publication date: 2021-01-27 (JP)

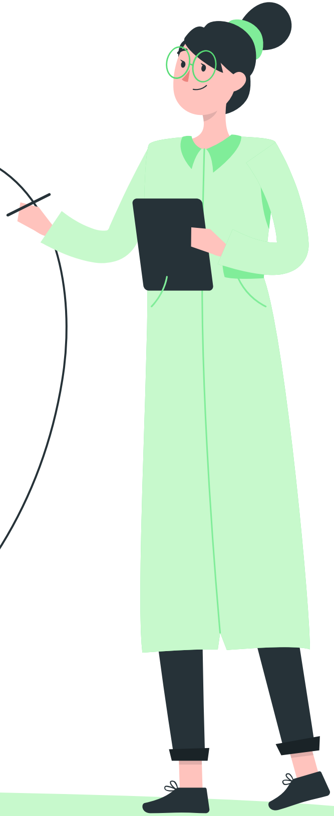


Extracted from:
https://patents.google.com/patent/US20200082225A1/en?q=(computer+vision+manufacturing+quality+control)&language=ENGLISH&oq=(computer+vision+manufacturing+quality+control)+language:ENGLISH&page=1



6

What’s next?



Next Steps

- Interconnect all the systems for the final prototype.
- Testing results to define the reliability and limitations of the performance.
- Optimization of parameters to meet the requirements of the client.
- Evaluate the risk of the limitations and compare to the original project definition.
- Define the specifications, claims and recommendations of the final product.

TRL4: Proof of Concept /Conclusions					/	/	/	/	/	/	P	P	P	P	P		P	P	P	MR
Testing and improvement			Hector	Team	/	/	/	/	/	/	/	/	/	/	/		P			
Summary of results			Teclo	Team	/	/	/	/	/	/	/	/	/	/	/		P			
Cost Estimation and final Business Case doc			Nathalie	Team	/	/	/	/	/	/	/	/	/	/	/		P			
Technology Readiness Assessment	8	0	Diego	Team	/	/	/	/	/	/	/	/	/	/	/			P		
Risk Assessment			Estefy	Team	/	/	/	/	/	/	/	/	/	/	/			P		
Final IPR recommendation			Antonio	Team	/	/	/	/	/	/	/	/	/	/	/			P	P	
Final Recommendations			Antonio	Team	/	/	/	/	/	/	/	/	/	/	/			P	P	
Consolidate TRL4 Report			Jose	Team	/	/	/	/	/	/	/	/	/	/	/					MR
Presenation TRL4			Jose	Team	/	/	/	/	/	/	/	/	/	/	/					MR

Major Risks

Time is the main concern. Right now we are all in on a solution that involves robot studio, python and orange. If for some reason the communication between the 3 were to fail or show to be inconsistent. Realistically, time wouldn't allow for a secondary solution to take place.

Robot Studio: working without an ABB Robot that already includes its own virtual controller is a challenge since the team lacks experience with the software and most digital resources assume that an ABB robot is chosen. However, as shown in the video, it is possible to create a full working station with a third party robot.

Computer vision: if the lighting conditions and other factors with which the training data was obtained can't be fully replicated or approached on the field, then we could see a drop in performance for the classification algorithm. Making a field run test and calibrating the algorithm would be an important step before implementing the final solution.