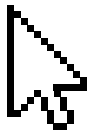
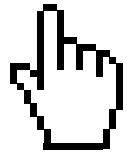
Mattia Morabito, Francesco Pallotto

RottenCAM:

Freshtastic - Redefining Produce Inspection



Here is where your produce inspection begins



01 Motivations

Why we did this project

02 Problem definition

What is our problem

03 Technical aspects

How we solved the problem

04 Ethics

What are the ethical implications

05 Market

What are the market applications

01

Motivations

17%

of food wasted at the consumer level

127kg

of food wasted annualy in the EU per inhabitant

9 Billion €

of wasted food value in Italy

“Imagine walking out of a grocery store with four bags of groceries, dropping one in the parking lot, and just not bothering to pick it up. That’s essentially what we’re doing.”

—Dana Gunders, Food & Agriculture Scientist

02

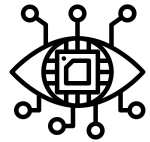
Problem Definition

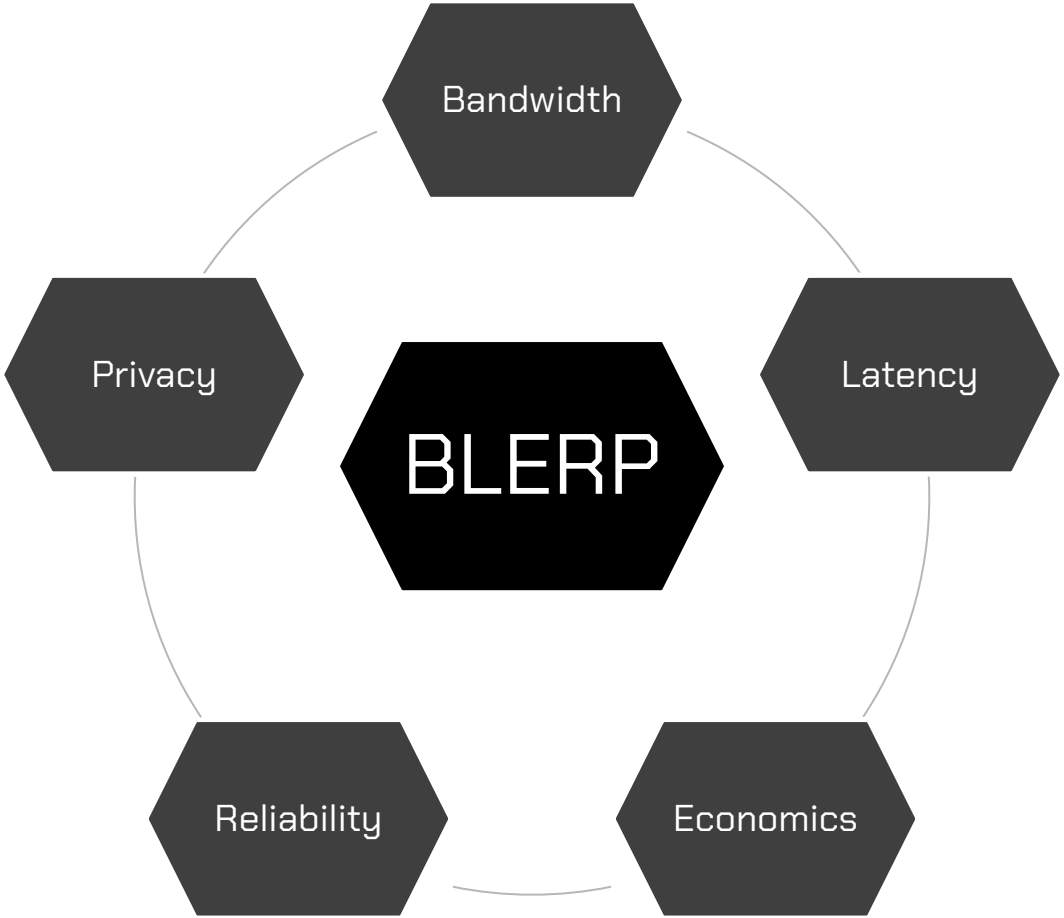
What is our problem

We want to create a computer vision algorithm to classify fresh and rotten produce

- Built for tiny devices
- Reliable and fast
- Ethical and Marketable

And the most important thing: the tool has to work!




Bandwidth
Latency
Economics
Reliability
Privacy
BLERP

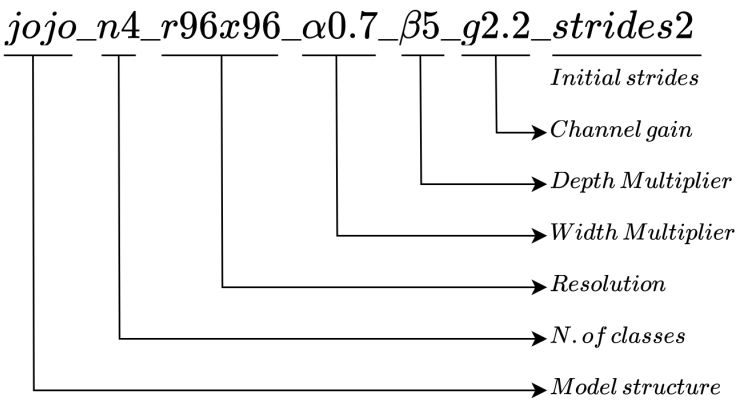
03

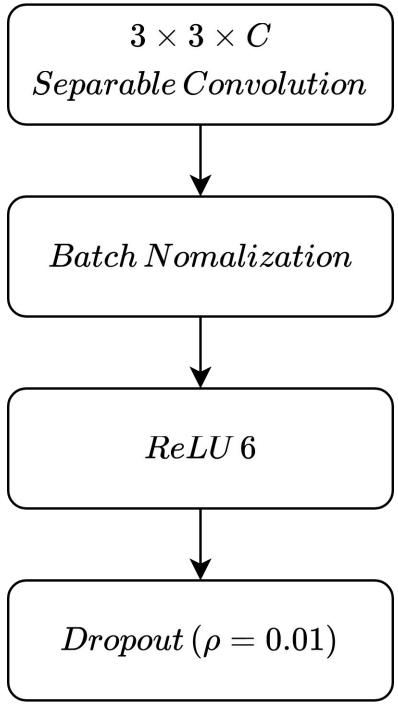
Technical aspects

How we solved the problem

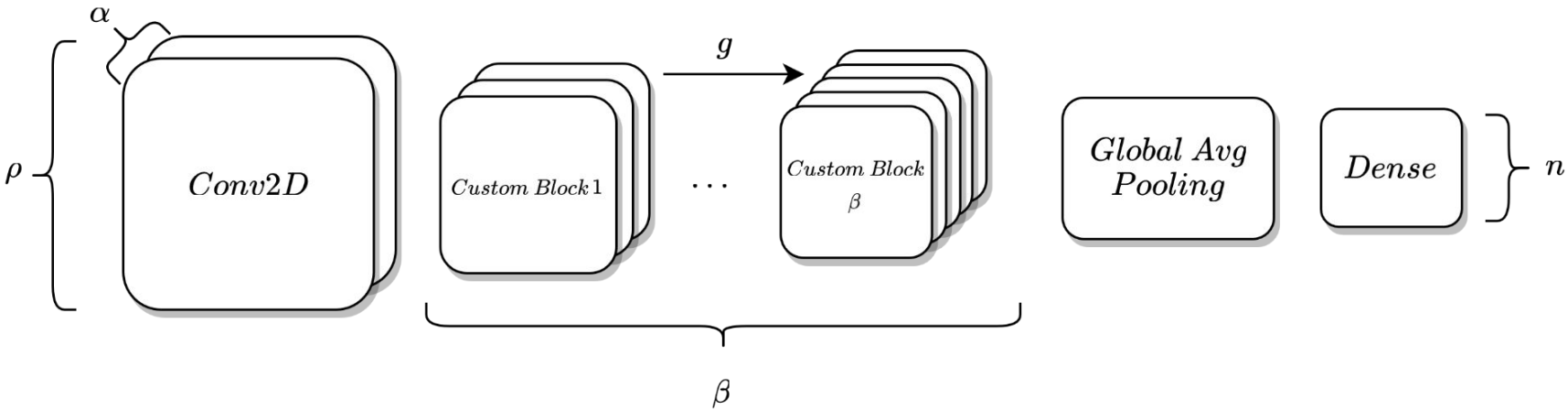
The first challenge is to define a tiny model that fits our technological constraints while keeping accuracy in mind. Our solution is to build a scalable model.

- Custom Separable convolution blocks
- Tuning hyperparameters

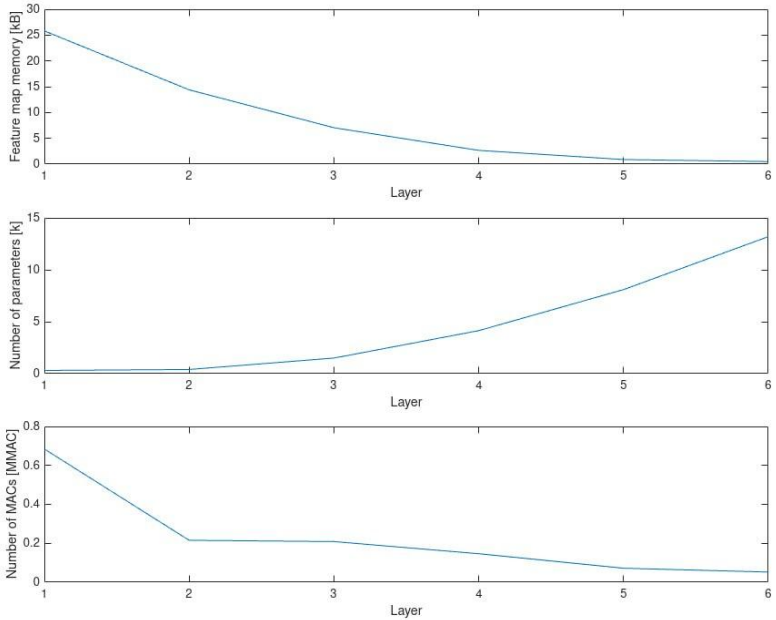


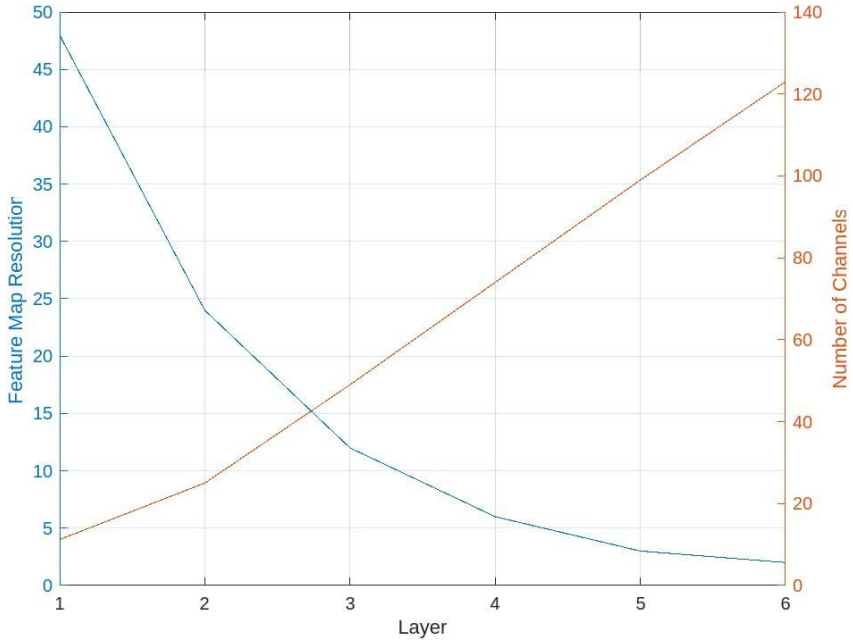


Block structure



$$C_i = \alpha \cdot C_{start} \cdot (i \cdot g)$$


Feature map memory [kB]
Layer
Number of parameters [k]
Layer
Number of MACs [MMAC]
Layer

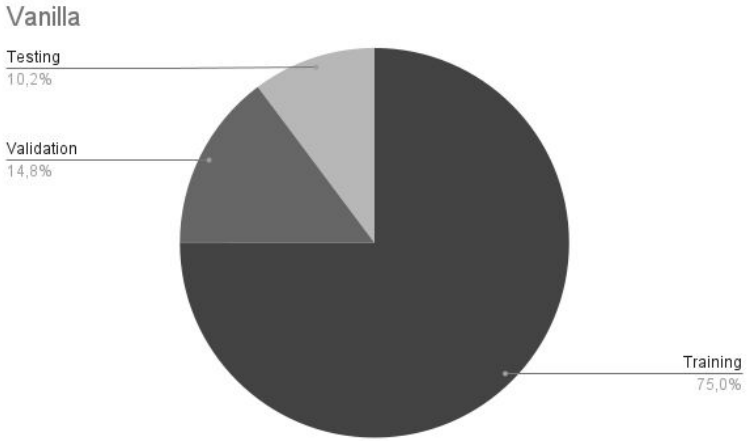

Feature Map Resolution
Number of Channels
Layer

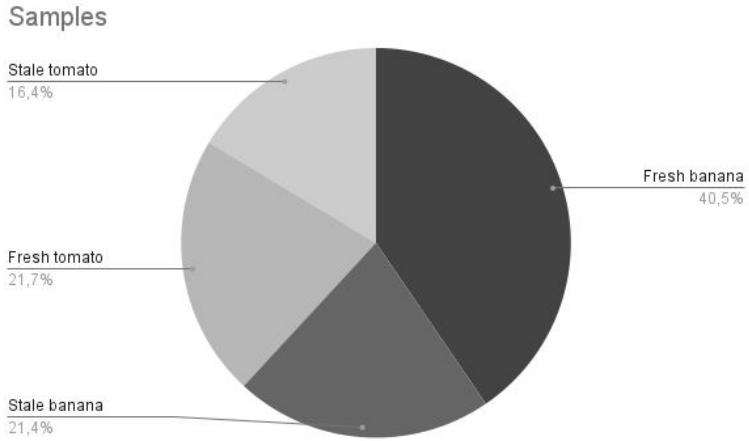
The second challenge is to find enough relevant data to train and test our model. We managed to get a total of around 5000 images from:

Source 1 (≈80%): Spoiled and fresh fruit inspection dataset

Source 2 (≈10%): Personal photos in various supermarkets (Milan, Messina, Macerata, Genova)

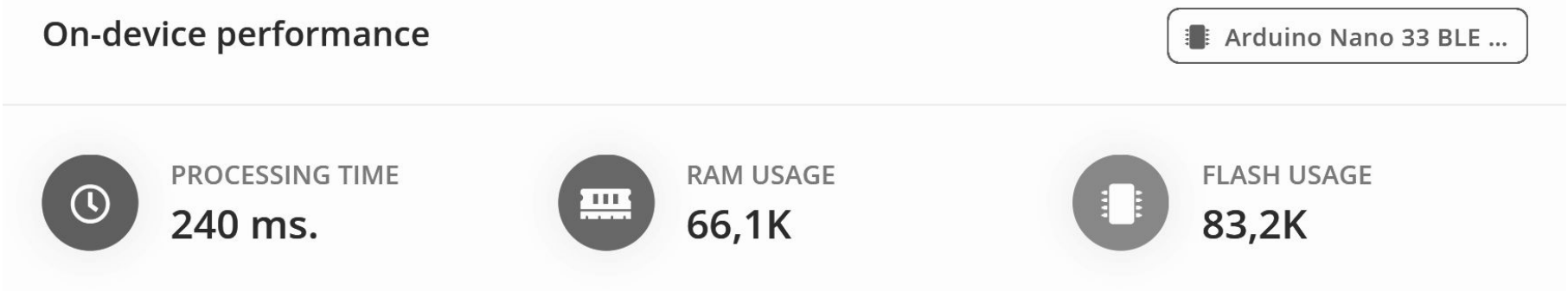
Source 3 (≈10%): Image scraping under Creative Common License.





Results

jojo_n4_r96x96_a0.7_b5_g2.2_strides2			
Number of parameters	Max consecutive Activations (kB)	MACs (M)	# layers
29605	39.744	1.38	23



Results

ACCURACY

91.49%

	F_BANANA	F_TOMATO	S_BANANA	S_TOMATO	UNCERTAIN
F_BANANA	93.2%	0.6%	3.7%	0%	2.5%
F_TOMATO	0%	87.8%	0%	6.8%	5.4%
S_BANANA	0%	0%	99.3%	0.7%	0%
S_TOMATO	0%	9.5%	0.9%	84.5%	5.2%
F1 SCORE	0.96	0.90	0.97	0.87	

- ➔ Y-axis: Predicted labels
- ➔ X-axis: True labels

04

Ethics

Increasing Criticality

Food Waste & Safety

Environmental conservation and sustainability

Data Ownership & Security

Safe and ethical handling of data

Workplace Surveillance & Job Displacement

Awareness and consideration of the impact of AI on the workforce

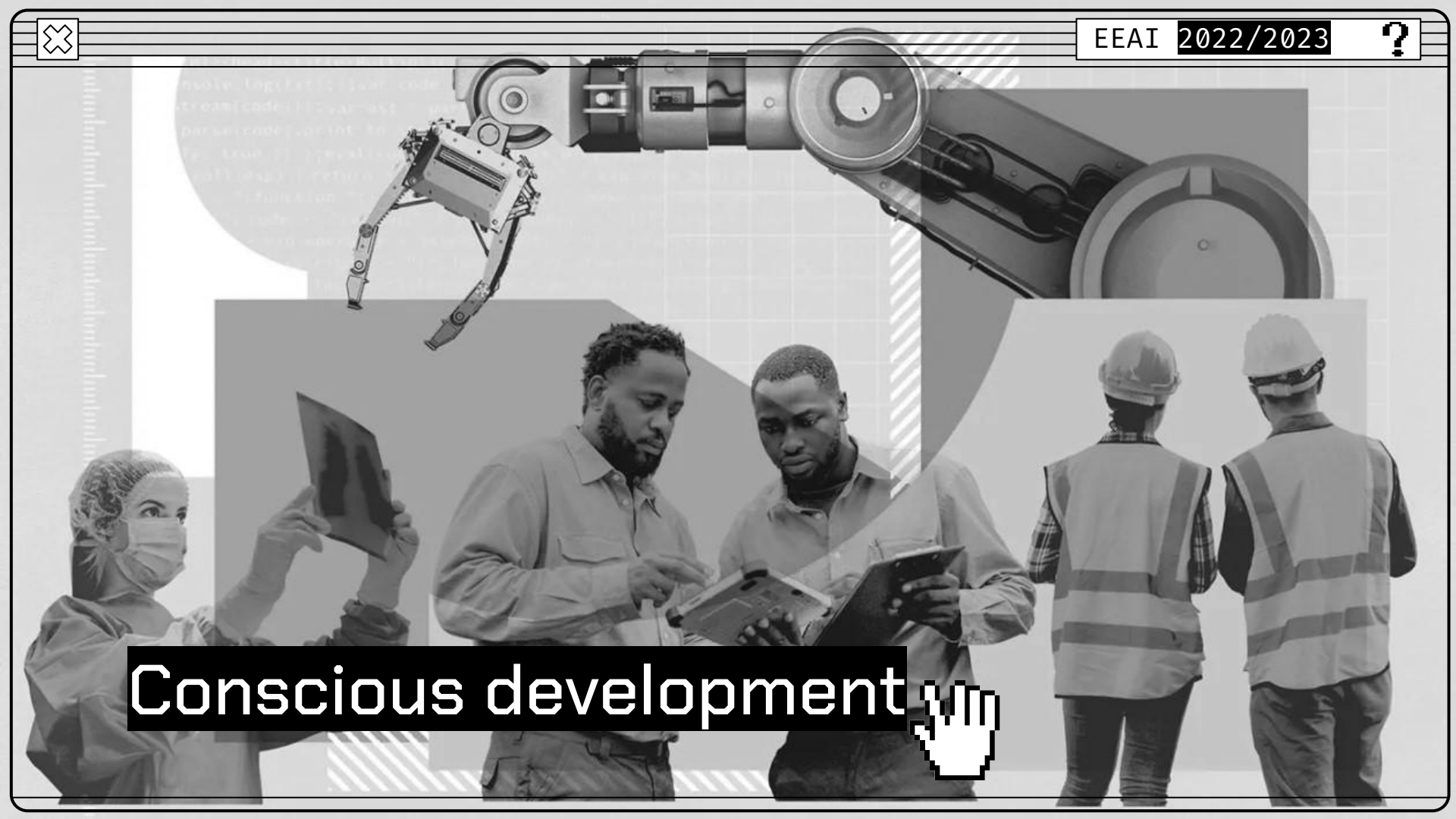
Reduction of food loss

$$FPR = \frac{FP}{FP + TN} = \frac{16}{16 + 279} \approx 5,4\%$$

	F_BANANA	F_TOMATO	S_BANANA	S_TOMATO	UNCERTAIN
F_BANANA	93.2%	0.6%	3.7%	0%	2.5%
F_TOMATO	0%	87.8%	0%	6.8%	5.4%
S_BANANA	0%	0%	99.3%	0.7%	0%
S_TOMATO	0%	9.5%	0.9%	84.5%	5.2%
F1 SCORE	0.96	0.90	0.97	0.87	

➔ Y-axis: Predicted labels
➔ X-axis: True labels

Privacy-oriented offline processing



Conscious development

05

Market

Three Stakeholders

Private Users

Aiding people in making more healthy and cost-effective decisions

Retail

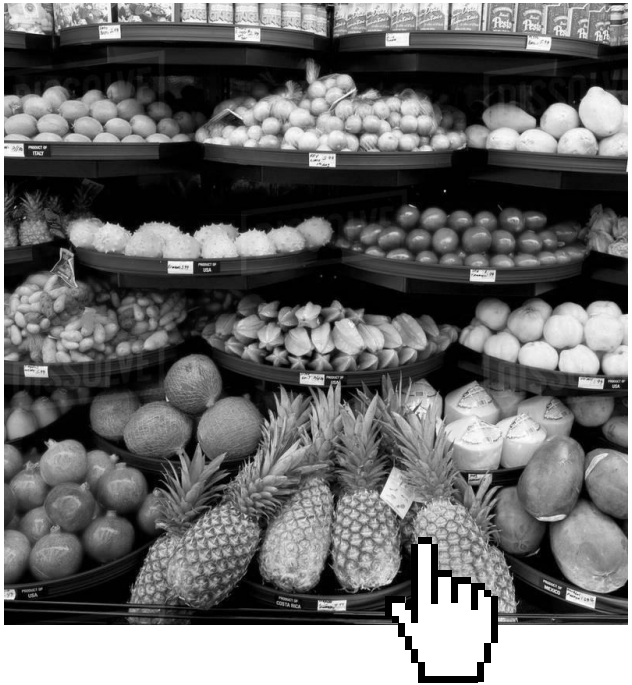
Empowering the retail sector with a reliable tool to handle their inventory

Industry

Streamlining the food sorting and grading process

Shop consciously and save money

Our model can be used to guide purchasing decisions to minimize spending and food waste.



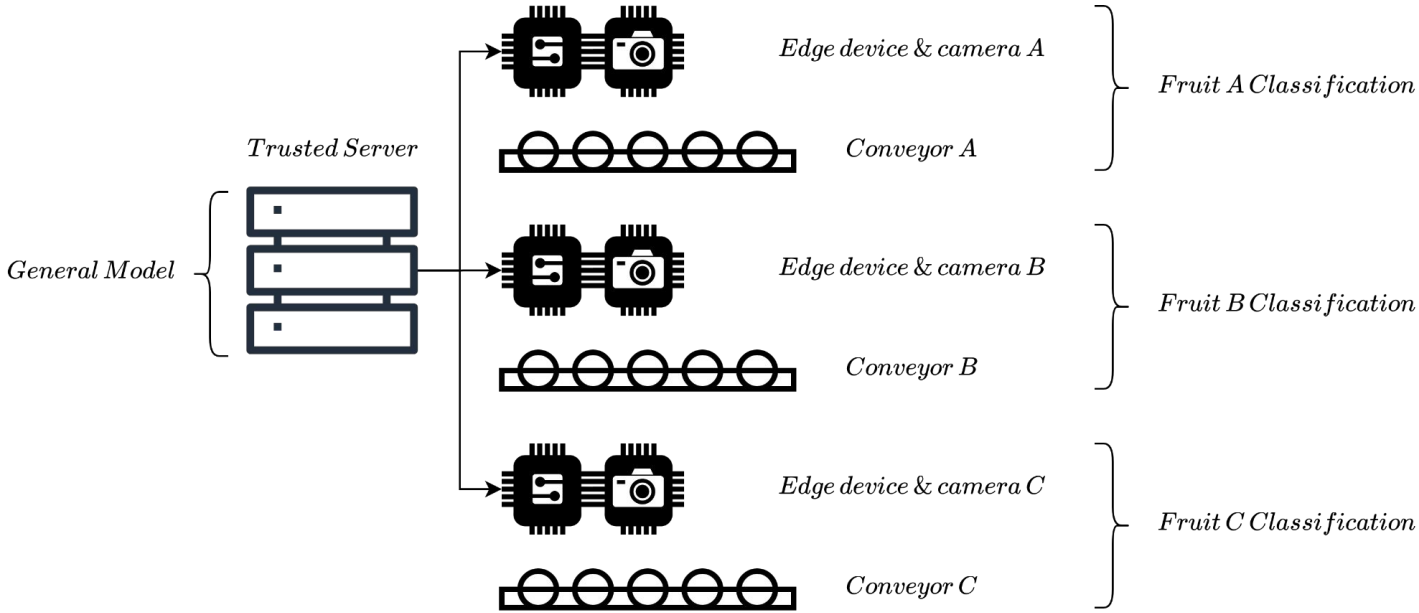
Reliable & fast inspections

With our device retail centers can quickly inspect deliveries and shelf items in a reliable way, improving inventory management and customer satisfaction.

Streamlining processes

A fast and easily maintainable edge device that reduces sorting time.

Federated Learning Approach



The biggest question

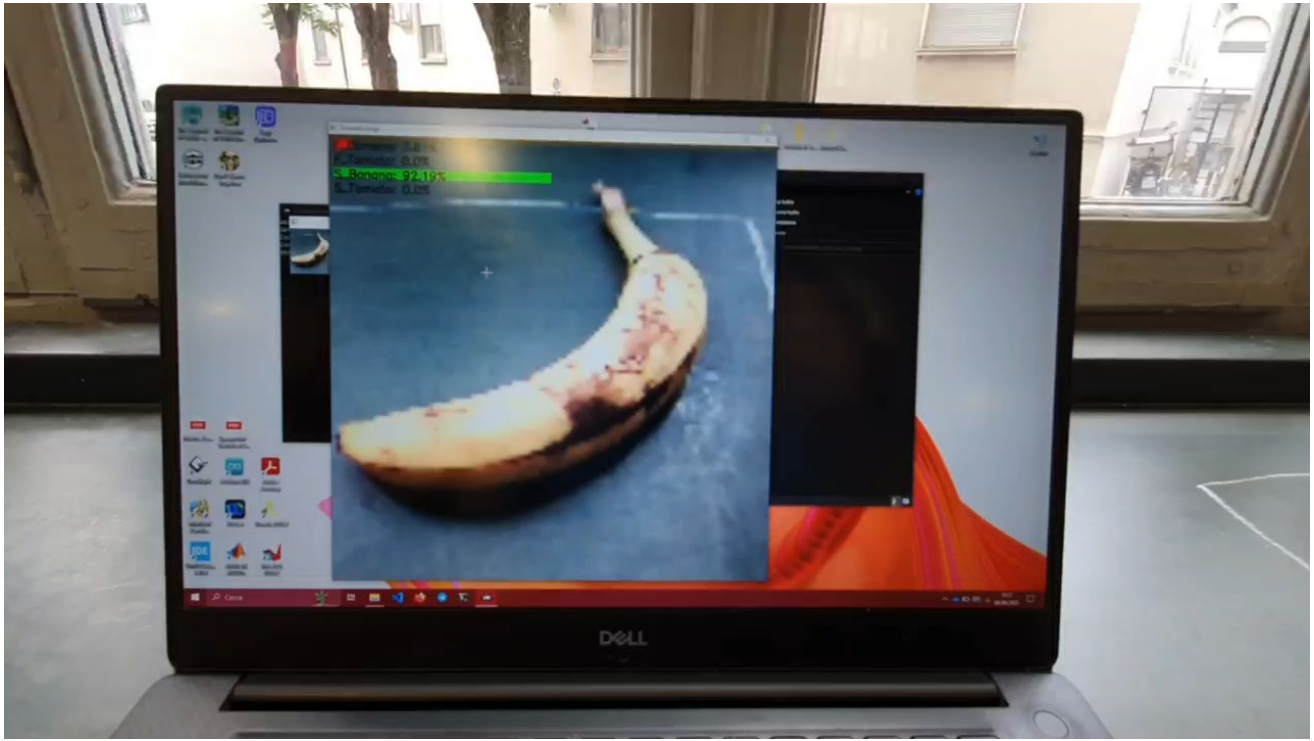
Does it work?

Our demo setup

Samples

Professional tripod

Vision area


F_Tomato: 0.0%
S_Banana: 92.19%
S_Tomato: 0.0%
DELL

Thanks!

Do you have any questions?

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