

# Real-Time Egg Detection Using Edge Computer Vision

*Nicholas Hadjisavvas, Nicolas Nicolaou, Efstathios Stavrakis*

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[www.algolysis.com](http://www.algolysis.com) 

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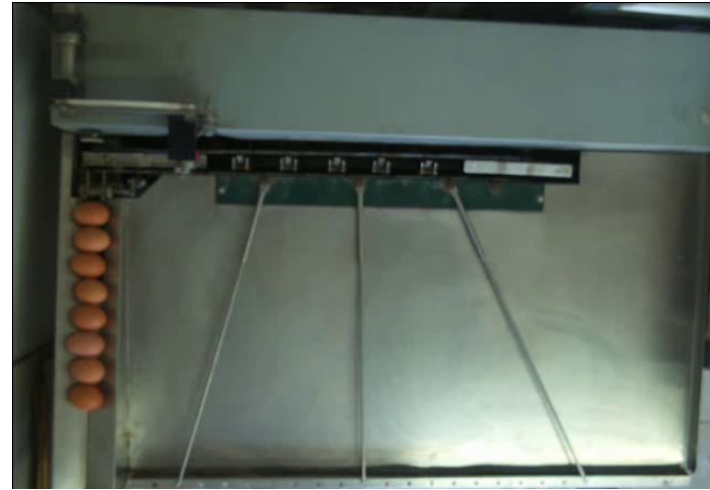
# Introduction

- Small farms/producers need to modernise/digitise processes.
- One such process: Egg counting.
- Egg counting could benefit from a technological solution.
- We attempted to:
  - Automate the egg counting process.
  - Retrofit legacy machinery with a smart counting device.
  - Cost optimisation.
- With the above attempt:
  - Optimised operations & allocation of labor.



# Motivation / Challenge

- Manual operation of egg counting machines consumes resources.
- Automate the above:
  - Smart retrofitting the machine using computer vision.



# Previous / Related work

## Egg counting

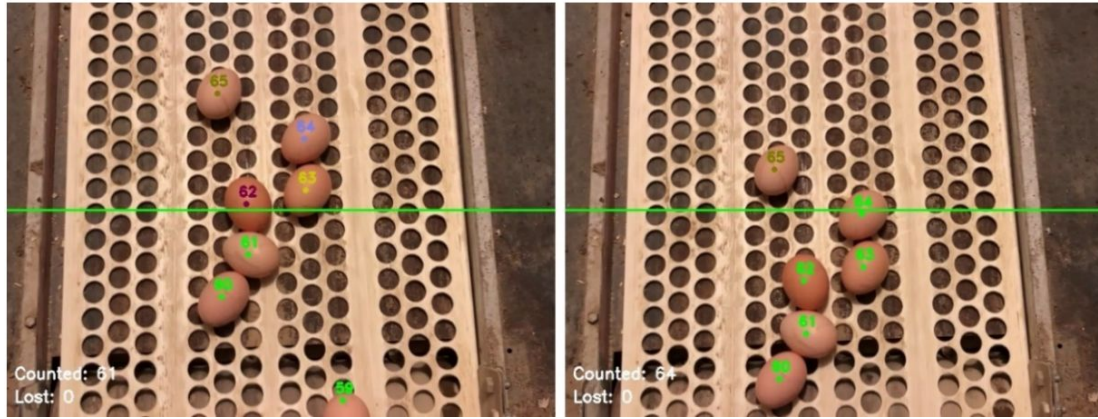
- M. Ulaszewski, R. Janowski, and A. Janowski, “Application of computer vision to egg detection on a production line in real time.” ELCVIA Electronic Letters on Computer Vision and Image Analysis, vol. 20
- I. Kanjanasurat, W. Krungseanmuang, V. Chaowalittawin, and B. Purahong, “Egg-counting system using image processing and a website for monitoring,” in 2021 7th International Conference on Engineering, Applied Sciences and Technology (ICEAST)

## Egg defect detection

- M. Omid, M. Soltani, M. H. Dehrouyeh, S. S. Mohtasebi, and H. Ahmadi, “An expert egg grading system based on machine vision and artificial intelligence techniques,” Journal of Food Engineering, vol. 118.



# Previous / Related work



M. Ulaszewski, R. Janowski, and A. Janowski, "Application of computer vision to egg detection on a production line in real time." ELCVIA Electronic Letters on Computer Vision and Image Analysis, vol. 20, no. 2, p. 113–143, 2022.

Method	Real number of eggs	Lost eggs	Multiple detected eggs	False positives	Not detected eggs	Detection Effectiveness
SSD-Mobilenetv2	335	1	18	0	0	94.33%
FR-CNN	335	0	5	0	0	98.51%
YOLOv3	335	0	4	0	0	98.81%
Template matching	335	41	15	0	31	74.03%



# Methodology

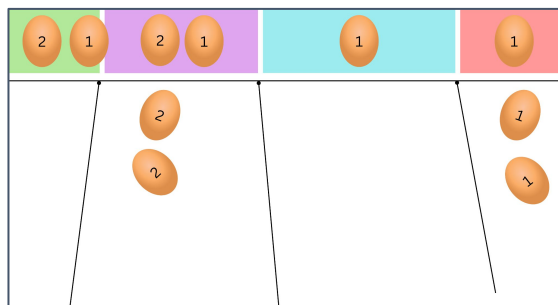
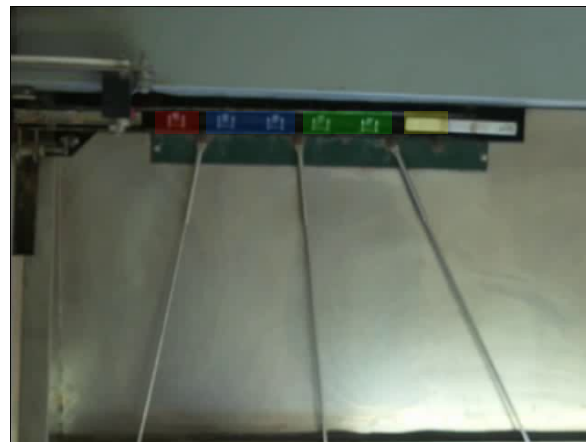
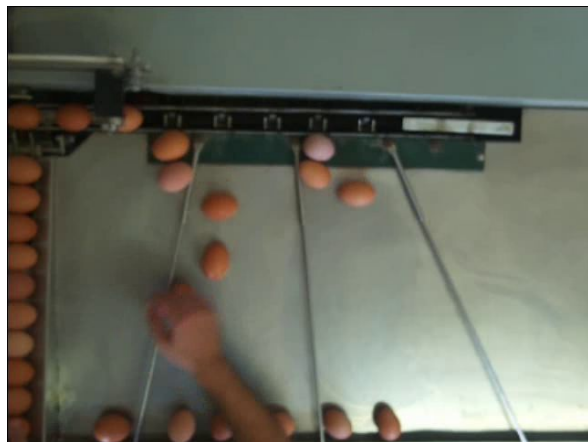
- Acquire images (2226 egg images)
- Train egg detection deep learning model
  - Computer vision to detect eggs being fed to a counting/sorting machine.
- On top of the model detections, apply tracking algorithm.
  - Our choice: Centroid tracking
- Using tracking results, count using region-of-interest.
  - Use unique identification of eggs to count each one only once.
- Auto-calibration method that enhances automation.



# Riva Selegg s21 grader: Video



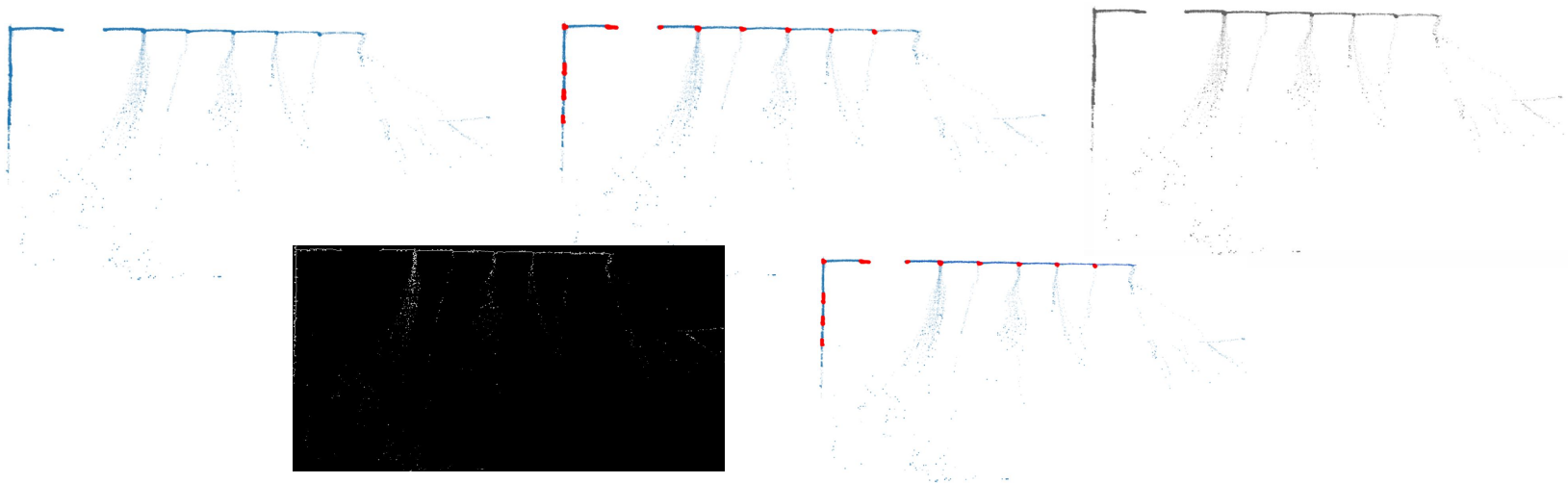
# Region-of-Interest Counting



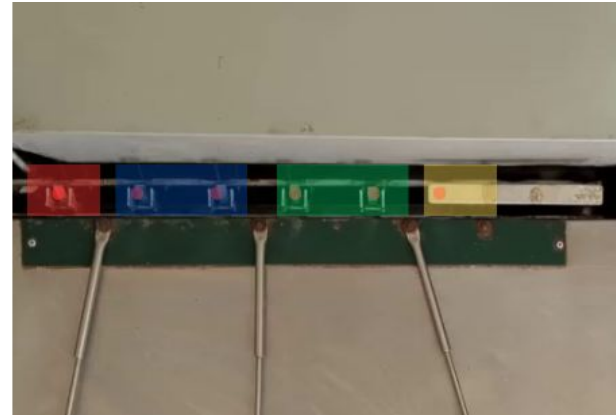
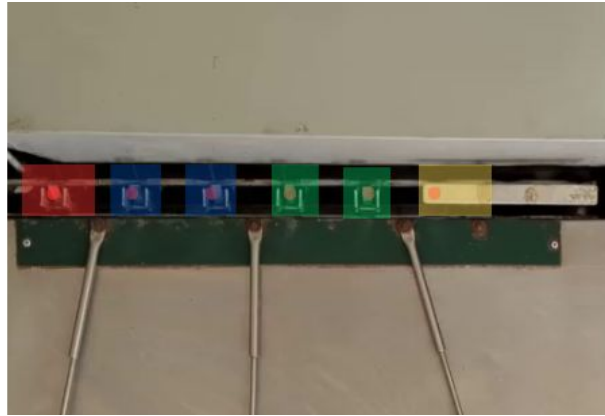
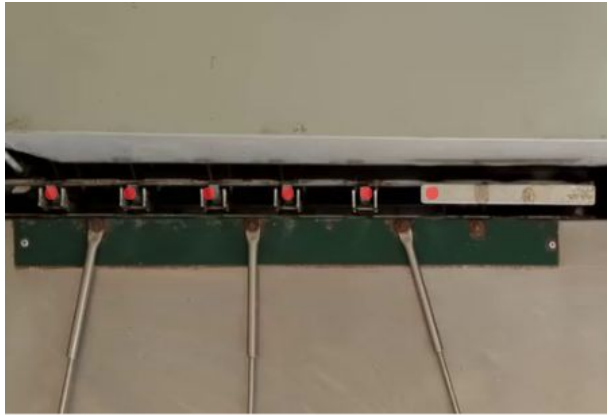
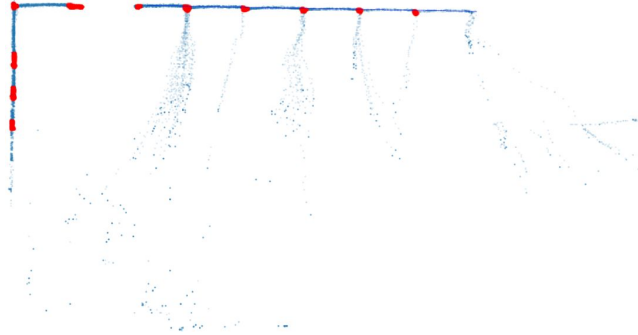


# Automatic Calibration

- How do we know which regions map to each egg grade?
- Calibration
  - Get tracked detections across many frames.
  - DBSCAN clustering to get densest locations.
  - Process results and use Hough transform to get regions.



# Automatic Calibration



# Demo video

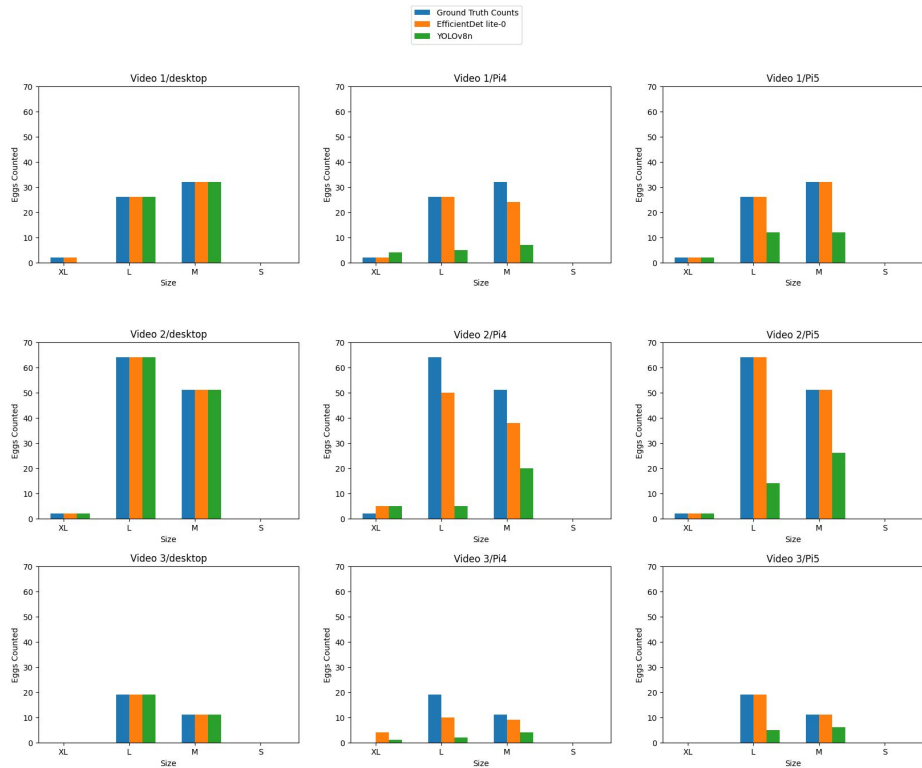


# Experiments and Results

video:grading_1		Ground Truth	2	26	32	0
		XL	L	M	S	
EfficientDet	Desktop	2	26	32	0	
EfficientDet	RPi5	2	26	32	0	
EfficientDet	RPi4	2	26	24	0	
YOLO	Desktop	0	26	32	0	
YOLO	RPi5	2	12	12	0	
YOLO	RPi4	4	5	7	0	

video:grading_2		Ground Truth	2	64	51	0
		XL	L	M	S	
EfficientDet	Desktop	2	64	51	0	
EfficientDet	RPi5	2	64	51	0	
EfficientDet	RPi4	5	50	38	0	
YOLO	Desktop	2	64	51	0	
YOLO	RPi5	2	14	26	0	
YOLO	RPi4	5	5	20	0	

video:grading_3		Ground Truth	0	19	11	0
		XL	L	M	S	
EfficientDet	Desktop	0	19	11	0	
EfficientDet	RPi5	0	19	11	0	
EfficientDet	RPi4	4	10	9	0	
YOLO	Desktop	0	19	11	0	
YOLO	RPi5	0	5	6	0	
YOLO	RPi4	1	2	4	0	



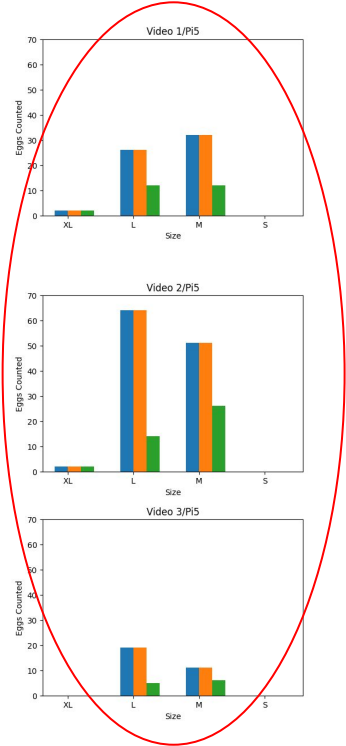
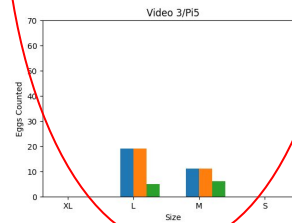
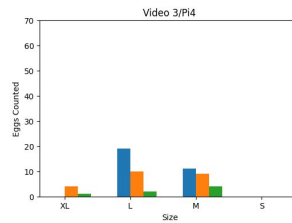
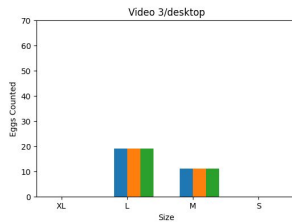
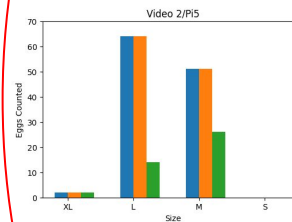
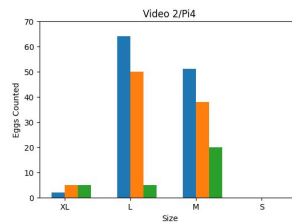
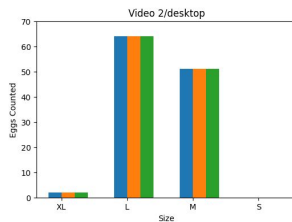
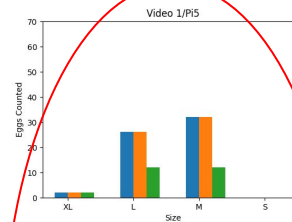
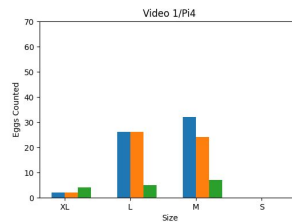
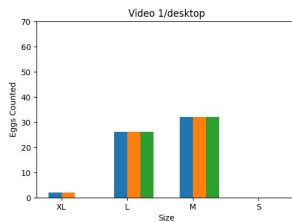
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YOLO	Desktop	0	19	11	0
YOLO	RPi5	0	5	6	0
YOLO	RPi4	1	2	4	0

■ Ground Truth Counts  
■ EfficientDet lite-0  
■ YOLOv8n



# Future work

- Generalise our tool
  - Make it suitable for several machine types.
- Extending evaluation process.
  - More diverse environments (lights, shadows, occlusions, etc.)
- More test samples.
  - To get a clearer view of the system's accuracy.



# Thank you!

## Real-Time Egg Detection Using Edge Computer Vision

### Questions?



<https://projects.algolysis.com/poultryfi/>

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 [research@algolysis.com](mailto:research@algolysis.com)