ANDANTE Tomato pests and diseases forecast

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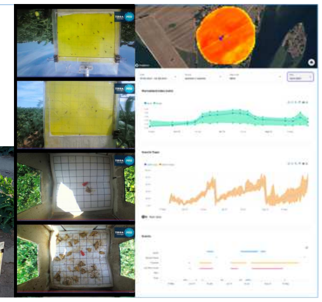
Overview & Setup

Objective: Implement an autonomous insects trap device to assist farmers in identifying the emergence of insect pests in remote areas. This device should be capable of:

- Counting autonomously the number of insects present in the trap.
- Being deployed in remote areas with network bandwidth restrictions.
- Having a low energy consumption for easier deployment and lower maintenance.

The trap consists of:

- A small cardboard house with sticky paper inside, soaked in pheromones to attract insects.
- A camera to acquire images from the sticky paper.
- A processing unit to analyse the images.
- A LoRa modem to communicate the results to the Analytics Platform.

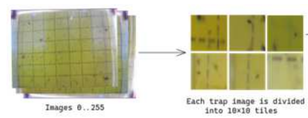


Technology

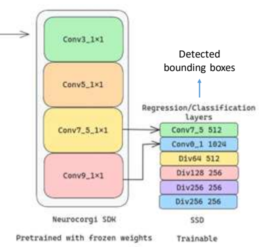
Platform 4.1a / ASIC 2.1

The demonstrator compares an insect trap cloud architecture where images are uploaded from the trap to a remote computer for analysis, with an edge-computing architecture, where all analysis are executed locally.

- For the cloud architecture, the YOLOv8 was chosen as the detection model, for being the industry standard for fast & and accurate detection.
- For the edge-computing architecture, a simulated environment of the platform 4.1a using ASIC 2.1 was used to execute the NeuroCorgi SDK backbone + an SSD head.



For better results on the detection of small insects, tilling technique was performed over each image.



Results

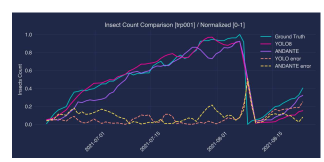
KPI Name	YOLOv8	SIMULATED	DIFFERENCE
AP50	0.75	0.56	-29%
RECALL	0.30	0.18	-12%
AP25	0.94	0.91	-3%
RECALL	0.39	0.29	-10%
Counting (avg error)	10.97 +/- 8.47	24.68 +/- 14.73	13.71%
Normalized [0-1] (avg error)	0.06 +/- 0.05	0.09 +/- 0.07	3%

Insect detection was achieved with **acceptable** error margins, but not human-level accuracy.

Insect counting & grow trends

Both models shows potential for population trend monitoring, especially when normalization is applied.

Insects counting comparison graph



Insects normalized counting comparison graph for scaled tiles

Impact

- A lower consumption device permit the construction of smaller insects traps, making them easier to deploy.
- The detection on the edge allow the image information to be compressed for transmission over longer distances.
- Farmers can be informed about pest growth rates in real-time.
- Permit localized actions over general preventive actions, avoiding the unnecessary use of pesticides.
- Minimizes potential crop damages, reduce the water usage and pesticides costs.

Progress beyond SoA

- A computational lighter AI model effective in the detection of insects was encountered.
- The crop of the images in tiles improve the insects detection.

Lessons learned

- The detection AI model works better with larger and shaper objects.
- A better image acquisition sensor and different sticky papers without the black grid marks should be tested to improve the detection accuracy.

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AI for New Devices And Technologies at the Edge

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