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Oil Palm Detection via Deep Transfer Learning

Isis Bonet, Fabio Caraffini, Alejandro Peña, Alejandro Puerta, Mario Gongora

EIA University, Envigado, Colombia

De Montfort University, Leicester, UK

Importance of oil palm:

- Cooking products
- Cleaning products
- Special greases and lubricants
- Personal hygiene and cosmetics
- Production of biodiesel and electrical energy
- Pharmaceutical

Why automate processes in oil palm cultivation?

- Pesticide spraying
- Plant health monitoring
- Weed detection

Aerial Image with UAVs

Identify palms help to precision farming and agriculture

- Prevention of fires
- Classification of different plant species
- Early diagnosis of plant diseases
- Counting out single plant units and in the census of live animals.

Contributions

This work proposes **a novel intelligent system for the automatic spatial identification of oil palm trees** based on:

- the collection of multispectral photographs with an UAV
- the generation of a data set suitable for designing and training AI solutions specifically tailored for the identification of oil palm units
- the use of advanced AI methods based on deep transfer learning to extract the features and identify the units.

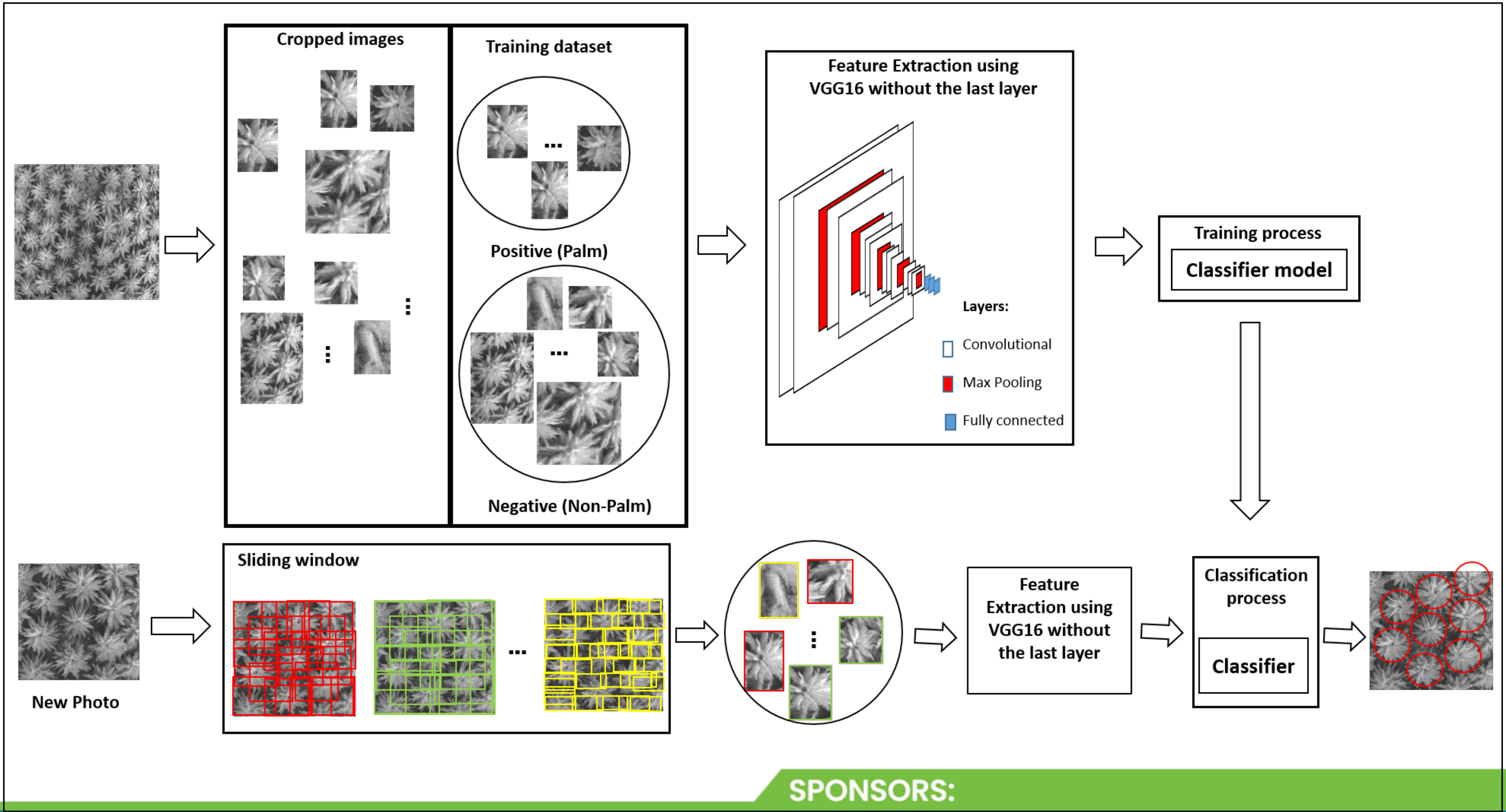
Collecting multi spectral photographs

- “Dji Phantom 3” drone equipped with a “Parrot sequoia” multispectral camera
- 4 different spectrum bands: Green (550 - 590nm), Red (660 - 700nm), Red Edge (735 - 745nm) and Near Infrared(790 - 830nm) with a resolution of 1280 960 for each band
- Multiple flights, each one covering 6400 palm units
- Different altitudes, i.e. 10m, 20m, 30m, 40m and 50m

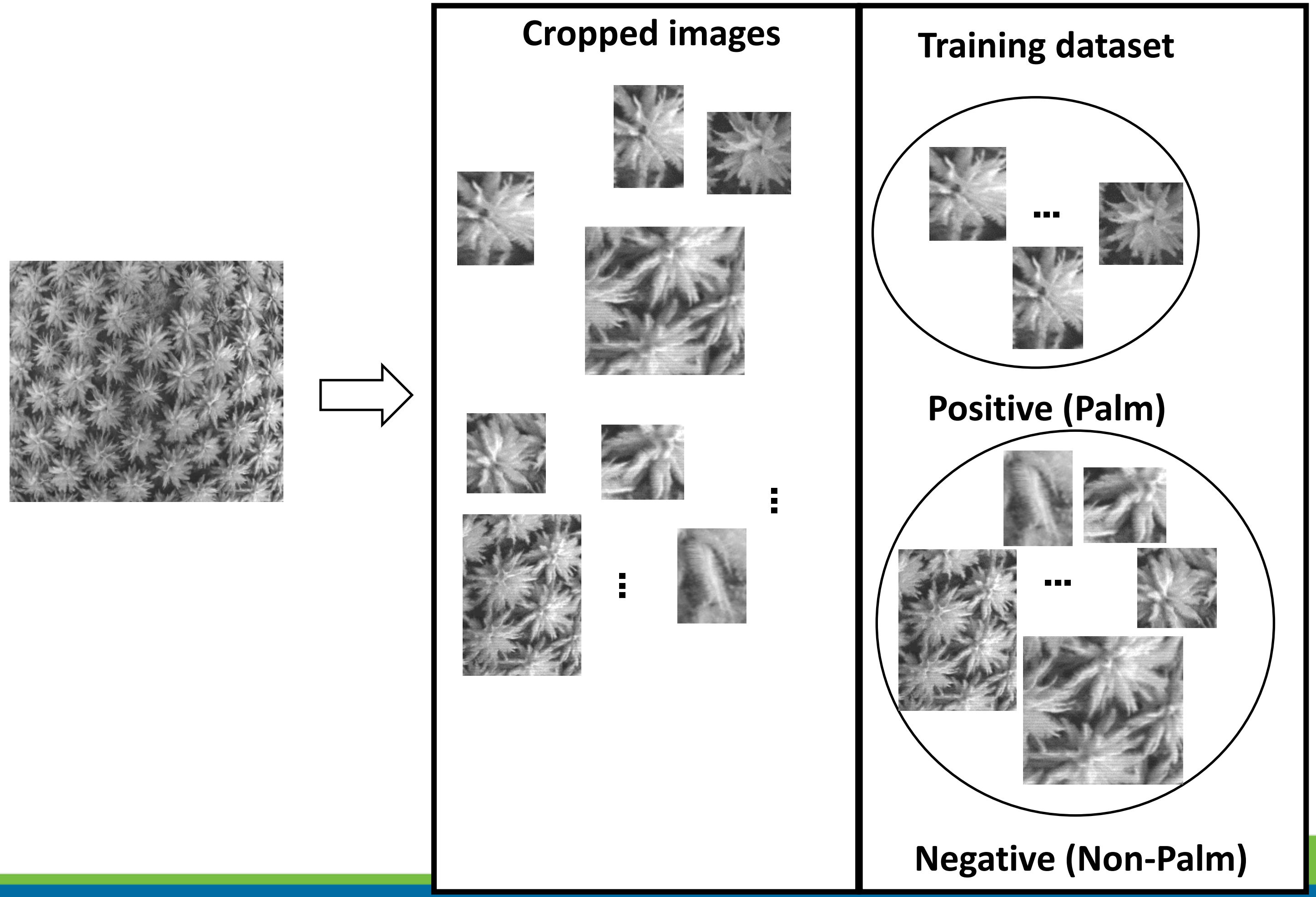
In total 400 photos were taken at each frequency band:

4 x 400 = **1600** images were collected

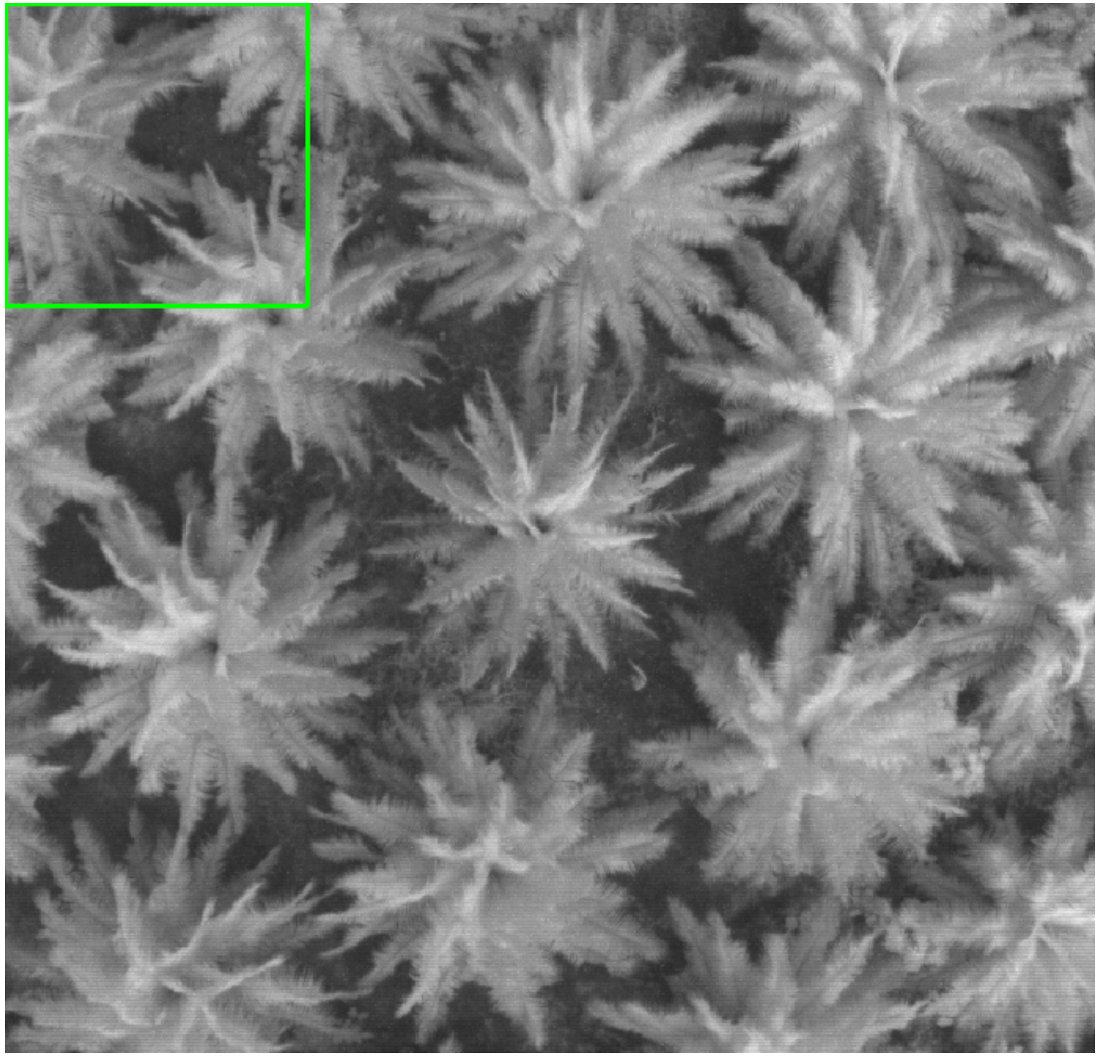
Training Process



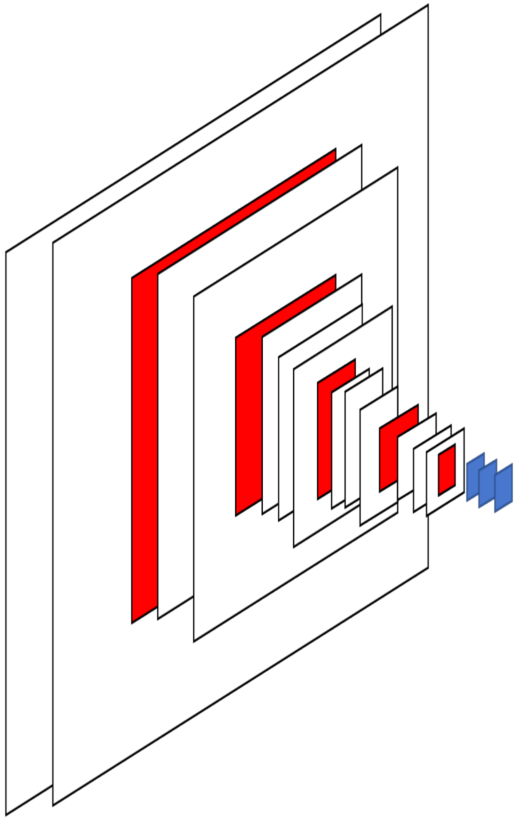
Building training dataset



Sliding Window



Convolutional Neural Network: VGG-16

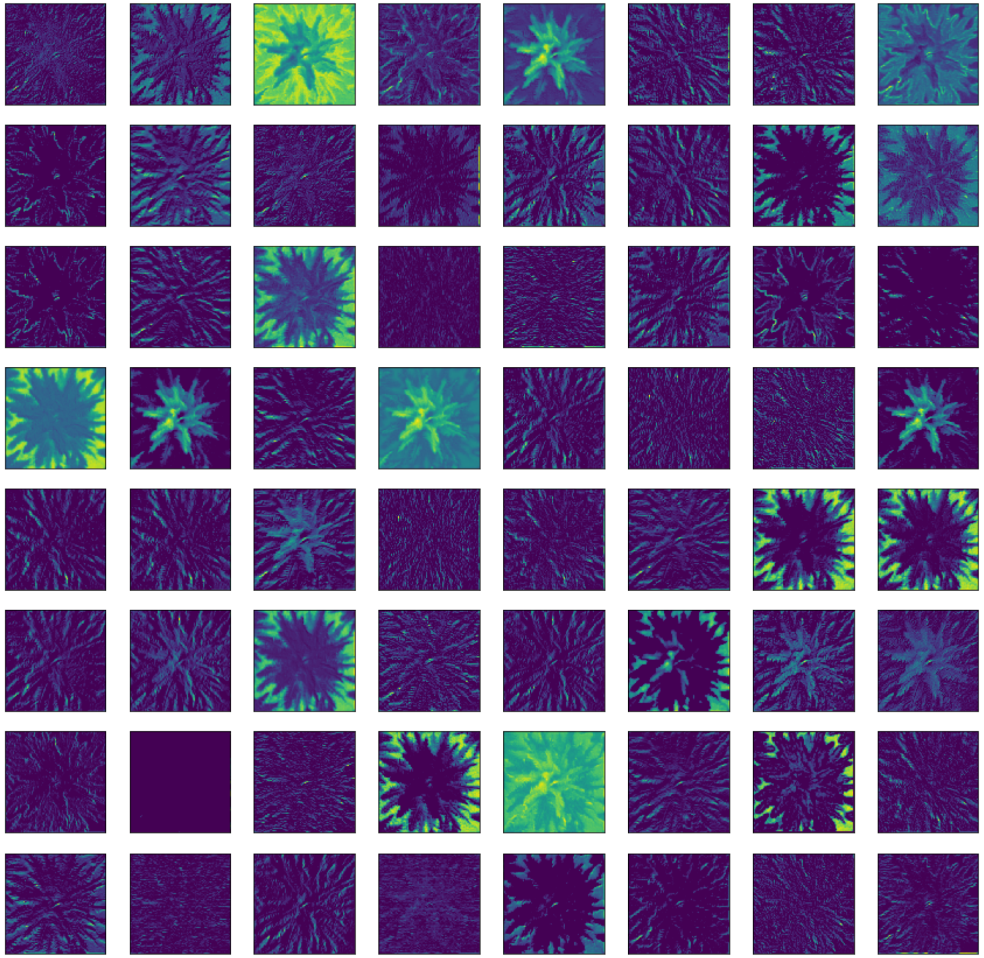


Layers:
- Convolutional
- Max Pooling
- Fully connected

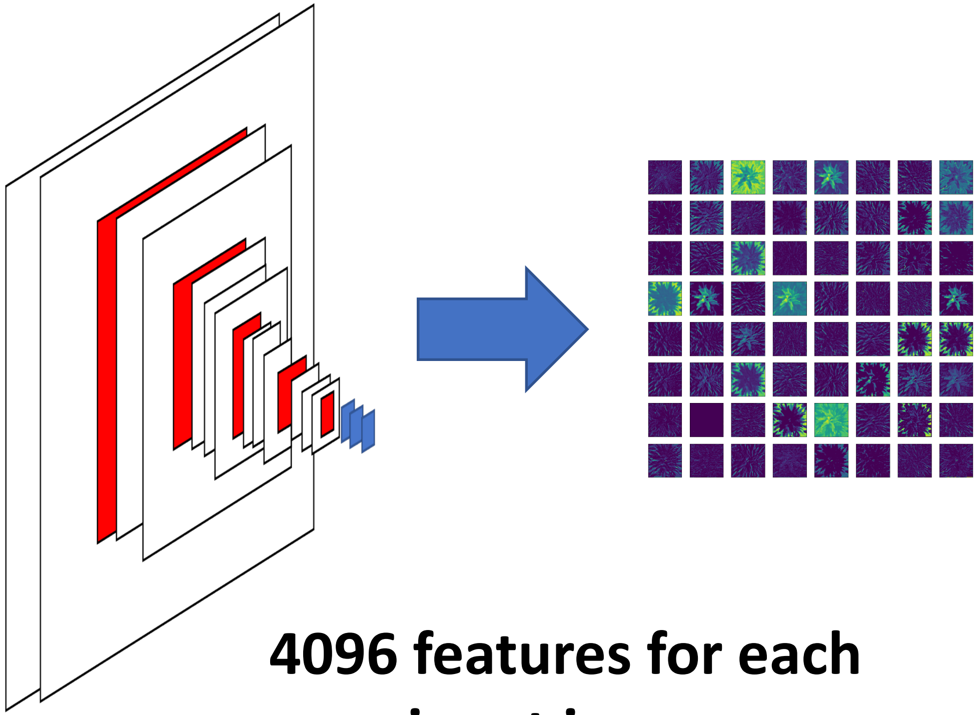
Transfer learning

Feature Extraction with VGG-16

Example of output of second layer

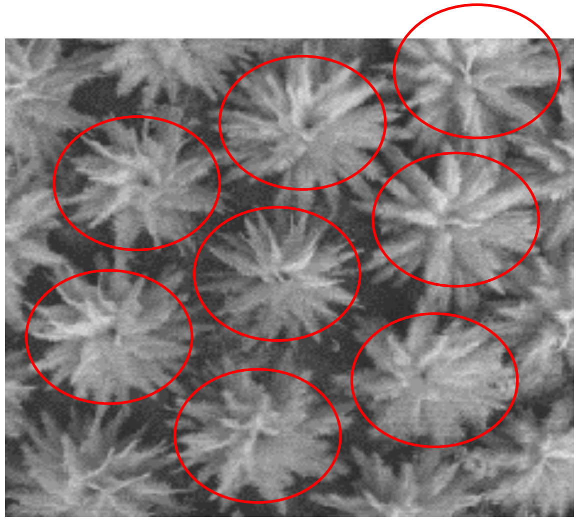


Classifier Model

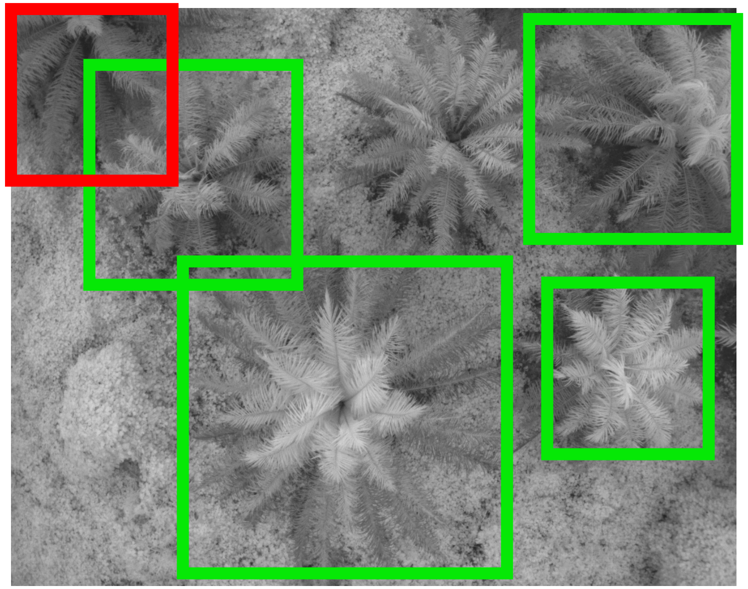


4096 features for each input image

+ SVM



Results of Oil palm unit detection



Database	Accuracy	F1	Precision	Recall
Training data (CV)	99.5%	99.6%	99.8%	99.5%
Validation	97.5%	97.1%	98.3%	97.7%

Using croosvalidation-10 fold

Conclusions

- Transfer learning is proven to be valid also in precision agriculture to pursue plants recognition.
- the jointly used of CNNs and SVM seems to be promising
- on top of being very accurate, the proposed approach is very flexible as it can be used straightaway for identifying similar plants, or a different variety if a new dataset is created for the training and validation
- the proposed classification method has a high potential impact since this technology can be used in large plantations to identify e.g. diseased units, or units needing assisted pollination.

Thank you!

isis.bonet@eia.edu.co
fabio.caraffini@dmu.ac.uk
juan.pena@eia.edu.co
alejandro.puerta@eia.edu.co
mgongora@dmu.ac.uk

Project:

https://dmu.figshare.com/articles/Intelligent_system_to_improve_the_sustainability_of_oil_palm_crops_through_the_construction_of_forecasting_maps/11638095

NIR Images Dataset:

https://dmu.figshare.com/articles/NIR_Dataset_for_Palm_Unit_Identification/11743098