

Instance Segmentation of Edamame Pods using Deep Learning

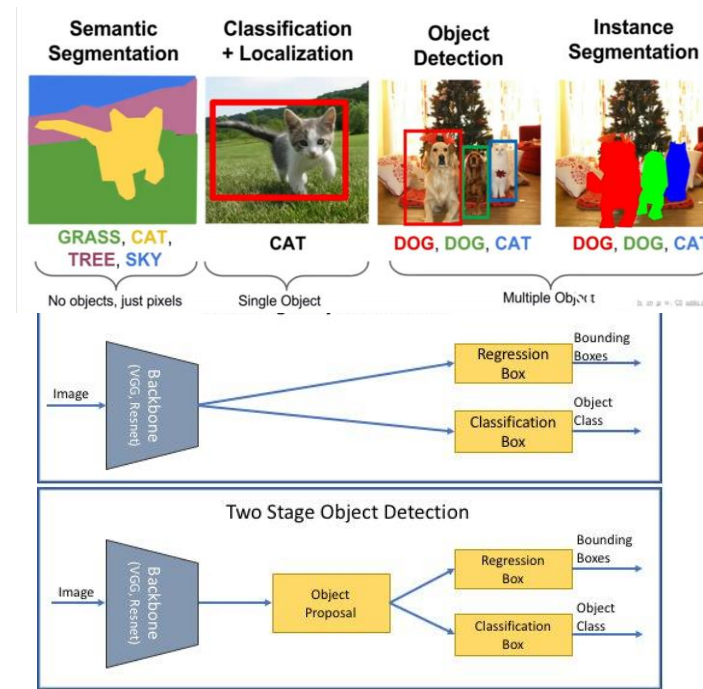
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Introduction: Edamame Pod Count



Object Detection Methods



Mask R-CNN and YOLO are the popular and state of the art object detection methods.

- **Mask R-CNN** is essentially the combination of a Faster R-CNN object detector and a fully convolutional network (FCN) for semantic segmentation, providing a complete, end-to-end, instance segmentation solution.
- The Mask R-CNN employs as feature extractor a feature pyramid network (FPN), an architecture able to create semantic feature maps for objects at multiple scales, built over a ResNet.
- **YOLOv5** is a family (YOLO networks proposed) of a single shot object detector meta-architecture and models pretrained on the COCO dataset
- The training step tries to minimize a loss function defined over such a tensor, performing detection and classification in a single step.

Dataset Preparation and Training Process

- For this project, we had a set of 190 images. We have split it into a 170 images training set and 10 images testing set (1123 pods) and 10 images for prediction.
- The input images have pixel sizes of $6000 \times 4000 \times 3$ tensors.
- Annotated using VGG Image Annotator and saved in json file format.
- All the networks were trained and tested on GPU (Nvidia GeForce GTX 1660 Ti) with a machine having Intel[®] core i5-9400 CPU, and 60 GHz processor.

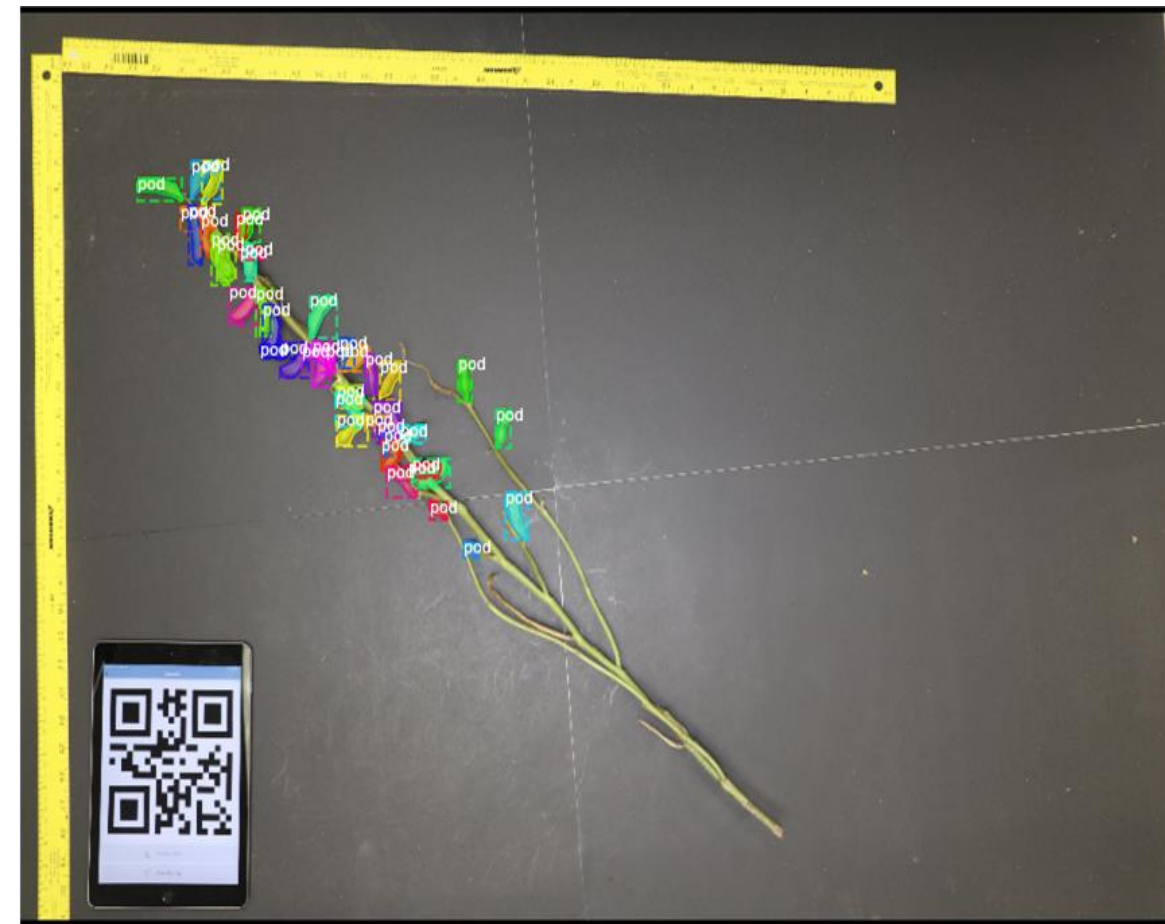
Mask-RCNN

- We employed Keras / TensorFlow-based implementation for Mask R-CNN by Matterport.
- Pixel level instance masks and point masks were used for training Mask R-CNN.
- The network was initialized using the weights previously computed for the COCO Dataset.
- Learning rate = 0.001, Number of Epochs= 100, Avg time per epoch= 8 mins.

YOLOv5

- The implementation of YOLOv5 was based on PyTorch; initialized using pre-trained weights from ImageNet.

Results : Prediction



Results :

Features	mAP	Precision	Recall	F1-Score	Accuracy
MRCNN	0.43	0.86	0.51	0.64	0.47
YOLOv5	0.66	1.00	0.70	0.82	0.85

Table 1.Parameters comparison for MRCNN and YOLOv5