AI HACKATHON 2019

Yield Prediction in Corn Fields

Team Registration ID - AIH19T-0212

Participant Details :

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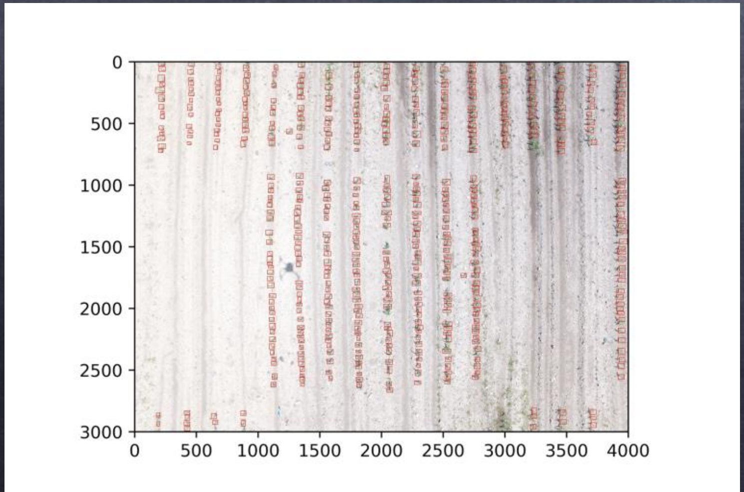
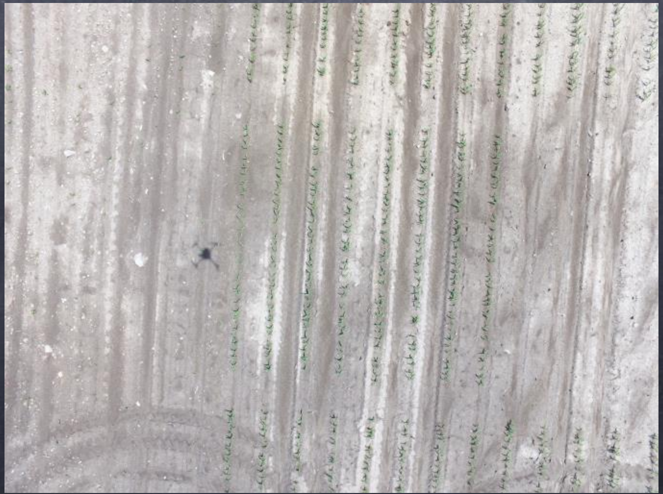
Background of the Problem Statement

- Corn is the third most important food crop after rice , wheat,
- According to advance estimates, it is cultivated in 8.7 m hectares
- Contributes to nearly 9% of the national food basket and around 100 billion to the agricultural GDP
- Generates employment for farmers, used as raw material for industrial products, staple food and quality feed for animals
- **Hence,** improve corn yields -> maximize farmer’s income -> improvement in the nation’s GDP
- Issue in India : Limited Land Resources, hence use of latest AI tech
- **Target Audience** : -Organizations interested in agricultural-based solutions.
- **Problem Statement Owner:- TartanSense**
  - Bengaluru-based, developing robots for small farms
  - robots can detect diseased plants and weeds, and precisely spray on the targeted plant

Understanding of the given dataset

- Set of RGB Images of corn fields showing crops captured at varying altitudes from drones.
- Size of images : 4000 x 3000
- Image set divided into two sub-folders : Marked & Unmarked
- Annotations of bounding box for crops in the marked folder of images
- No. of marked images in the train set : 101
- GPS Coordinates of some images



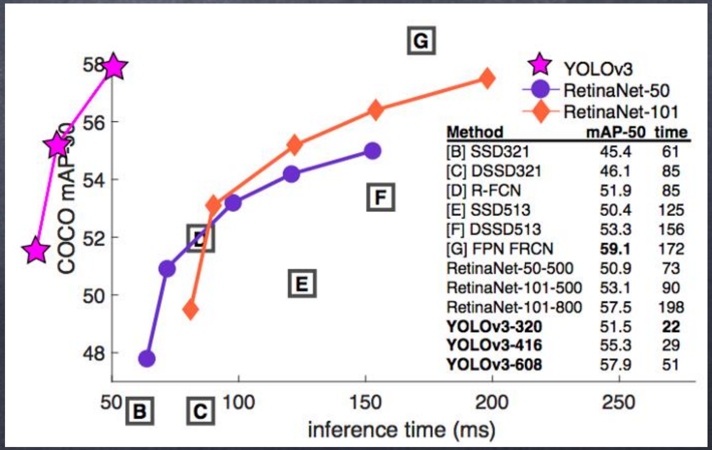


YOLO Framework

➢ WHAT?
- Train the Darknet-53 used in YoloV3.

➢ WHY?
- Better Accuracy than most of the other model for detection
- Realtime Performance
- Can detect smaller objects when compared to previous versions of YOLO.
- Processes the whole image at once and thus learns contextual patterns such as crops are planted in a linear manner and also leads to a negligible false positive rate.

➢ HOW?
- Used the keras-tensorflow implementation of YoloV3 in python.



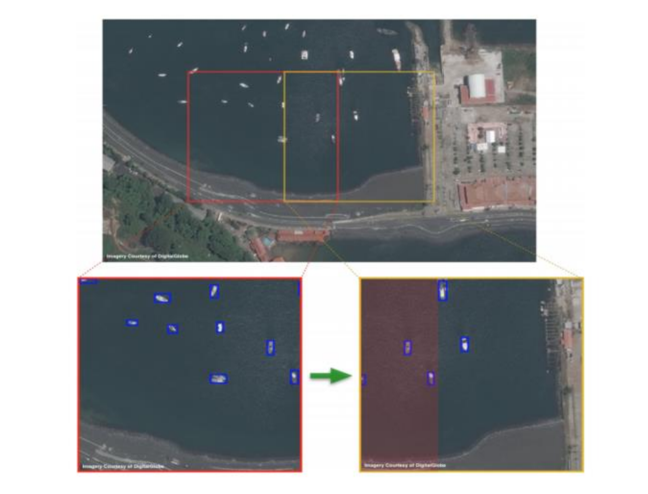
Selecting the right implementation

1. **<u>YOLOV3-Keras -></u>**

- set anchor boxes manually
- good accuracy
- high inference time on high resolution images
- unable to train on high resolution images due to ‘out of memory’ issues
- Running extremely slowly on Titan V100 GPU

<u>YOLT -></u>

- rapidly handle the extremely large file sizes of satellite imagery
- uses the sliding window approach
- increases inference time due to re-stitching of the images



Using Tiny-YOLOv3

Features :

- small network, training was possible on full resolution of input images
- very low inference time which was around 2ms(from 1.5sec in keras) for low resolution images
- 20ms(from 8sec in keras) for higher resolution images.

Data preprocessing:

- Random 180 degree crop field image rotations
- Random Horizontal Flips
- Resizing image in a range while training(possible because network is fully convolutional)

Fine-tuning the parameters :

- increased the number of anchor boxes
- predicts per grid from 5 to 9
- removed around 4 layers which were supposed to detect larger size objects
- not completed the training on full resolution images (only 30 images)
- it accepts larger images for inferencing

Training & Deployment

Training :

- Separated low altitude images from the dataset
- Recall Rate of 95%
- For high altitude images, performed tiling on the images , 9-12 tiles
- Recall rate for high altitude : 60-70%
- Multi-GPU usage :

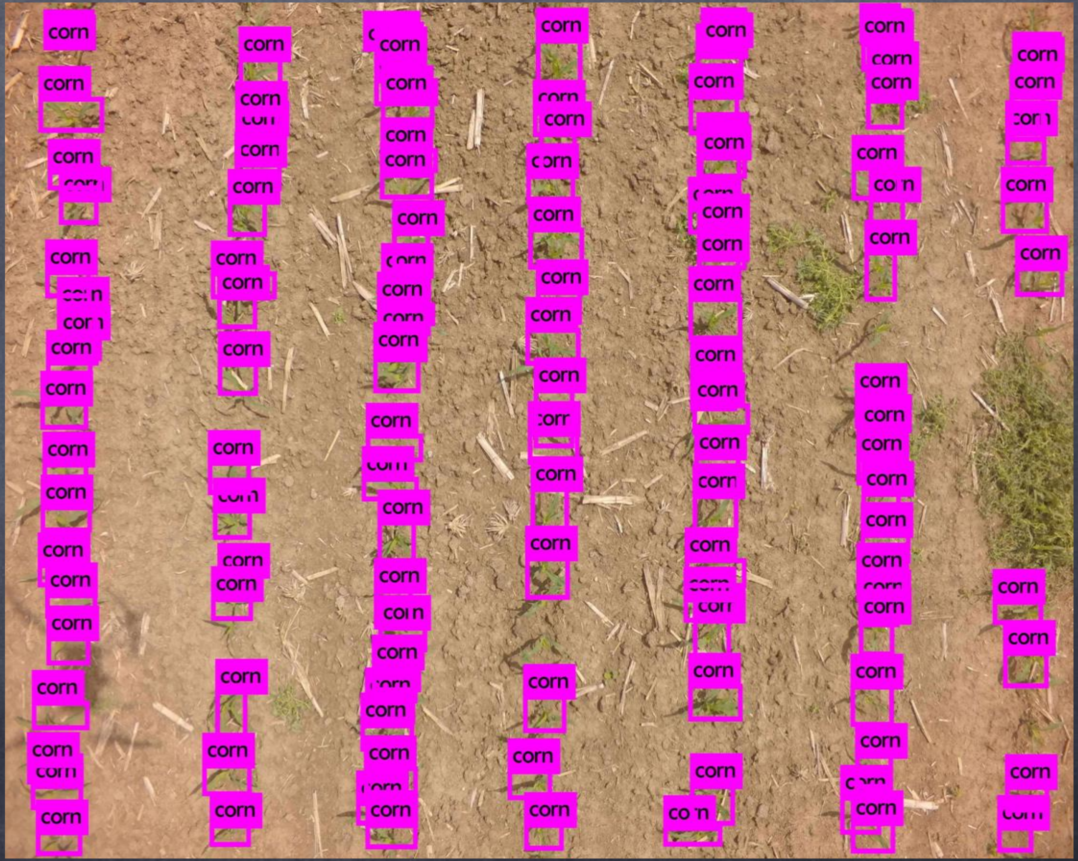
  Tesla P100-PCIE (2 nodes)

Testing Results & Deployment :

- **Testing time : 0.089 seconds for 4K high altitude images**
- **For low altitude images : (416 x 416) 0.002 seconds**
- **Deployable in the real-world on unknown images , gives good accuracy**
- **<u>mAP values : 36%</u>**

Outputs from the Model

Original Image from the given dataset



Crops detected by the model

Learning Experience over the 5-day hackathon

- Tools and techniques for extremely efficient inferencing in neural networks without compromising accuracy, like NVIDIA TensorRT
- F2F interaction with industry experts
- Gained experience on solving issues that are faced during production deployment
- Had the opportunity to understand work ethics in project management while working on CDAC cluster.
- Received insights on the importance of business skills / rules required while designing an AI solution.
- Collaboration among team members

What Next ?

- Top 2 things we would like to do , given more time :
    - Train on unmarked images in the given dataset using annotated images predicted by the model (Semi - Supervised Learning)
    - Optimize the images further for production deployment by using libraries like NVIDIA TensorRT

Future Directions

- Since most farmers cannot afford drones, these can be provided by the Govt.
    - Govt. can supervise over farms
- The existing solution can be extended to detect multiple crops present in the same image as well as detection of weeds for spraying pesticides.
- During our research we came across other state of the art frameworks that look promising for this use case, like CentreNet

Thank You

Link to the solution folder

/home/aih07/STAGE3_AIH19T_0212_Solution/