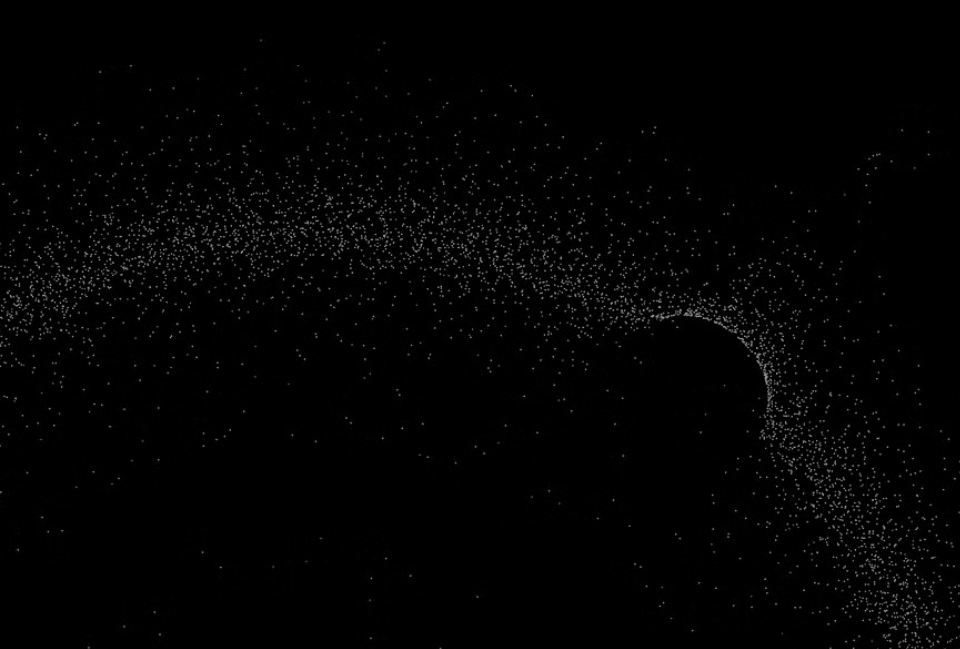


Davis Mechatronics Solar Installation – Pole Identification

Rosh

Content



1 Label images



2 Image augmentation



3 Select models - YOLO family



4 Tune training & threshold parameters



5 Results



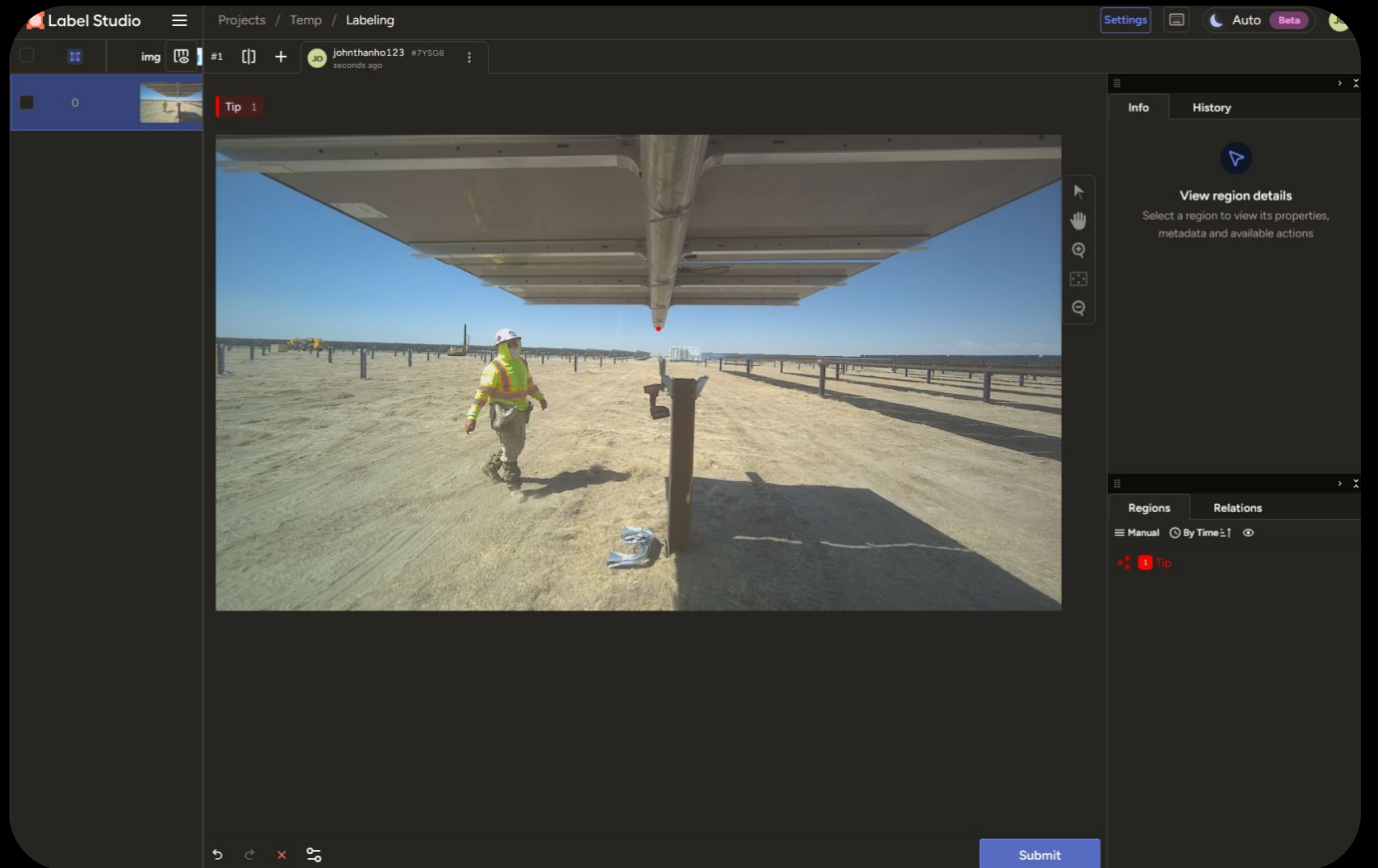
6 To Change



Davis Mechatronics Solar Installation - Pole Identification

- 1 Label images
- 2 Image augmentation
- 3 Select models - YOLO family
- 4 Tune training & threshold parameters
- 5 Results
- 6 To Change

Label-Studio



Data Labelling + Augmentation

1



Data Label
Using Label-Studio

2



YOLO Conversion

1. Omit Depth (only RGB)
2. Convert point to box (20x20px)
3. Normalize values to YOLO (center_x, center_y, width, height)

3



Data Augmentation

Random combination of: x-axis flip, brightness, contrast, gaussian noise, saturation

Model, Fine-tune & Parameters

- YOLO
 - CNN-based (v8s)
 - Transformers -> overkill
 - Low latency
 - Good track-record
 - Efficient - runs on most devices
- Alternative: RT_DETR (transformer based)
- Bigger issue: lack of data
- Model: v8s
- Epoch: 100
- Image size: 640
- Batch: 16 (vram limit w/ GPU)
- Optimizer: SGD
- Confidence threshold: 0.01 (100% accuracy, a few false positives (better than omission))



Results (0) - RGB

Localization Error (pixels):

- Mean: 0.90 px
- Median: 0.69 px
- Std Dev: 0.69 px
- Min: 0.06 px
- Max: 4.25 px
- 95th %ile: 2.43 px

Detection Metrics:

- True Positives (TP): 246 / 306 (80.4%)
- False Positives (FP): 0 / 306 (0.0%)
- False Negatives (FN): 60 / 306 (19.6%) - primarily augmented



Results (1) - RGB

Performance Metrics:

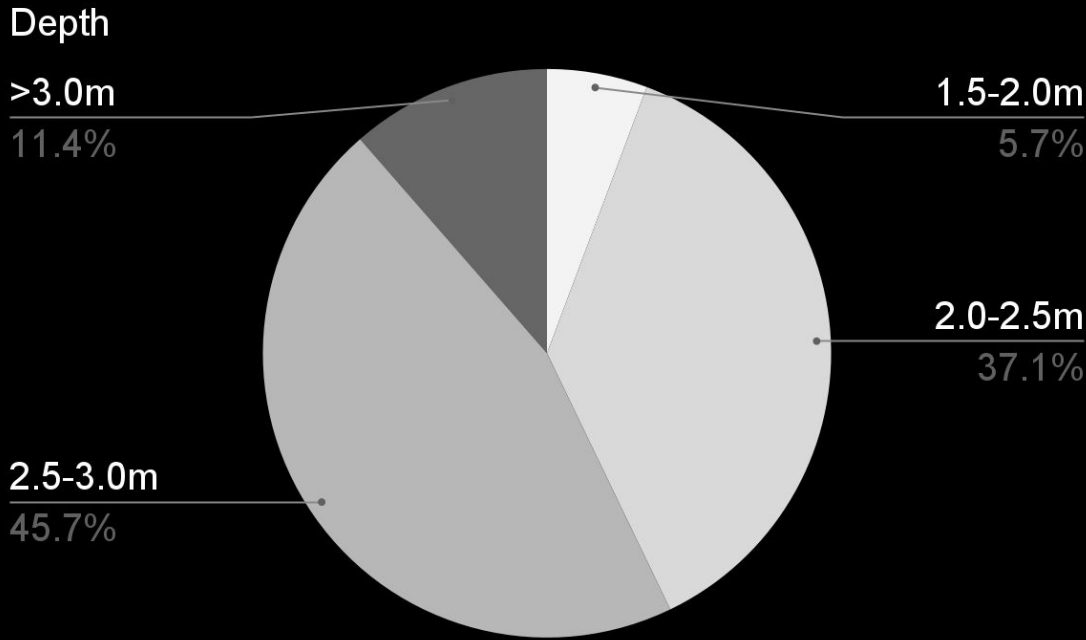
- Accuracy: 0.8039 (80.39%)
- Precision: 1.0000 (100.00%)
 - Correct ID-ing
- Recall: 0.8039 (80.39%)
 - No ID-ing when there is a pole
 - Primarily augmented results false negative
 - Confidence threshold already 0.01
- F1-Score: 0.8913 (89.13%)

False Negatives (No Detection): 60

```
=====
1. 20250826_111213_front_frame000001_rgb_aug002.png
   GT: ( 936.2, 435.4)
2. 20250826_111213_front_frame000001_rgb_aug007.png
   GT: ( 936.2, 435.4)
3. 20250826_111213_front_frame000001_rgb_aug008.png
   GT: ( 983.8, 435.4)
4. 20250826_111217_rear_frame000004_rgb_aug000.png
   GT: ( 960.0, 384.9)
   GT: ( 983.8, 435.4)
4. 20250826_111217_rear_frame000004_rgb_aug000.png
   GT: ( 983.8, 435.4)
   GT: ( 983.8, 435.4)
   GT: ( 983.8, 435.4)
4. 20250826_111217_rear_frame000004_rgb_aug000.png
   GT: ( 983.8, 435.4)
4. 20250826_111217_rear_frame000004_rgb_aug000.png
   GT: ( 983.8, 435.4)
   GT: ( 983.8, 435.4)
4. 20250826_111217_rear_frame000004_rgb_aug000.png
   GT: ( 960.0, 384.9)
5. 20250826_111217_rear_frame000004_rgb_aug001.png
   GT: ( 960.0, 384.9)
6. 20250826_111219_front_frame000007_rgb_aug001.png
   GT: ( 936.2, 439.9)
7. 20250826_112339_front_frame000173_rgb.png
   GT: ( 960.0, 384.9)
5. 20250826_111217_rear_frame000004_rgb_aug001.png
   GT: ( 960.0, 384.9)
6. 20250826_111219_front_frame000007_rgb_aug001.png
   GT: ( 936.2, 439.9)
7. 20250826_112339_front_frame000173_rgb.png
   GT: ( 985.3, 431.0)
8. 20250826_112339_front_frame000173_rgb_aug000.png
   GT: ( 985.3, 431.0)
9. 20250826_112339_front_frame000173_rgb_aug001.png
   GT: ( 985.3, 431.0)
10. 20250826_112359_front_frame000191_rgb.png
    GT: ( 985.3, 432.4)
```


Results (2) - Depth

Metric	Value
Mean depth	2.587 m
Median depth	2.546 m
Std deviation	0.324 m
Min depth	1.895 m
Max depth	3.414 m



Results

Metric	Value
Mean depth	2.587 m
Median depth	2.546 m
Std deviation	0.324 m
Min depth	1.895 m
Max depth	3.414 m



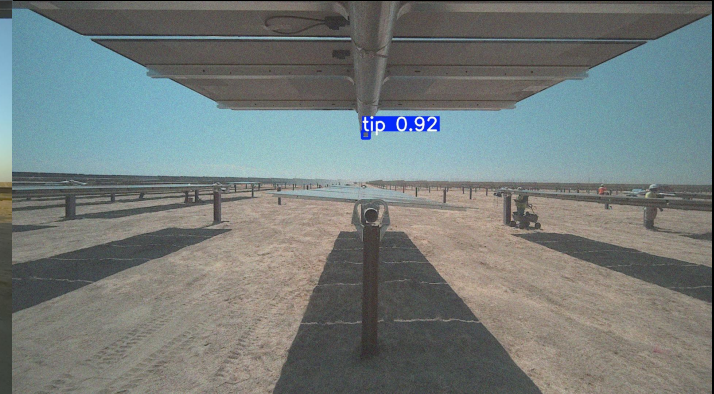
Results (3)

Showcase



Results (4)

Showcase



Results (5)

Showcase





To Improve

- YOLO compatible labeling/bounding box labelling instead of dot coordination
 - Makes benchmarking easier
- Docker setup (pain w/ label-studio dependents)
- Include more instances of no pole tips

