Report on Person Detection and PPE Detection Models

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1. Introduction

The objective of this report is to detail the methodologies, learning processes, and evaluation metrics used in developing two YOLOv8 models: one for person detection and another for Personal Protective Equipment (PPE) detection. These models are crucial for ensuring workplace safety by identifying the presence of individuals and verifying the usage of required protective gear.

2. Approaches

Person Detection Model

Model Architecture: YOLOv8

- **Purpose**: To detect and locate persons in images.
- **Training Data**: A dataset consisting of images annotated with bounding boxes around persons.

PPE Detection Model

Model Architecture : YOLOv8

- **Purpose** : To detect and identify different types of PPE such as helmets, vests, and gloves.
- **Training Data**: A dataset with images annotated with bounding boxes around various types of PPE.

3. Learning Process

Data Preparation

Annotation: Both datasets were annotated using the Pascal VOC format, specifying the coordinates of bounding boxes and class labels.

Splitting: The datasets were split into training (80%) and validation (20%) sets to evaluate model performance. **Model Training**

Hyperparameters :

- **Batch Size** : 16
- **Epochs** : 20

Optimization : Adam optimizer was used with weight decay to prevent overfitting.

Loss Function : A combination of localization loss, confidence loss, and classification loss.

4. Evaluation Metrics

Accuracy

Measures the proportion of correct predictions out of the total predictions. However, in object detection, more specific metrics are used.

Precision, Recall, and F1-Score

- • **Precision** : The ratio of true positive detections to the total predicted positives.
- **Recall** : The ratio of true positive detections to the total actual positives.
  F1-Score : The harmonic mean of precision and recall, providing a single metric that

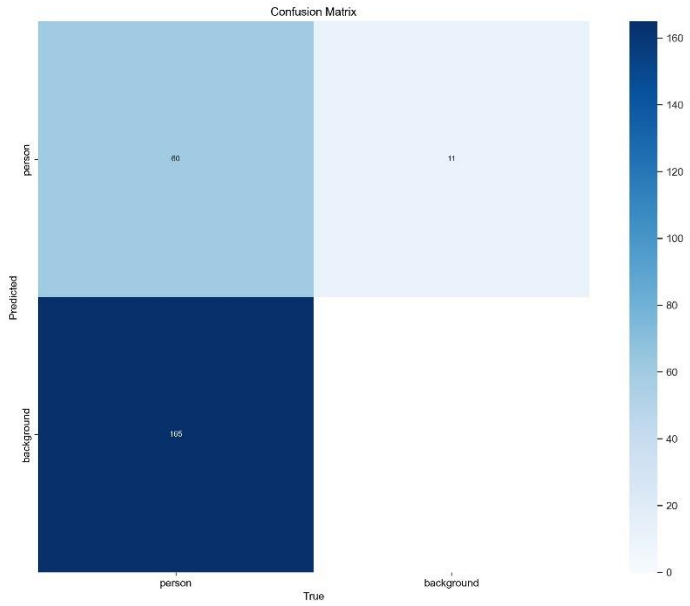
  balances b

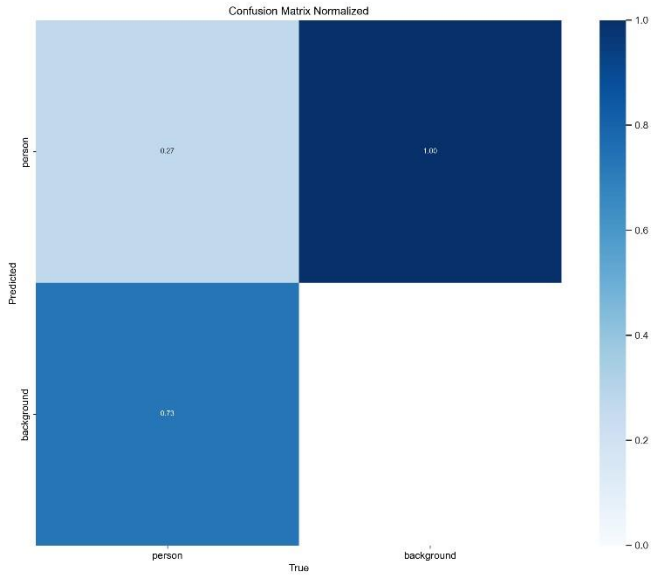
Mean Average Precision (mAP)

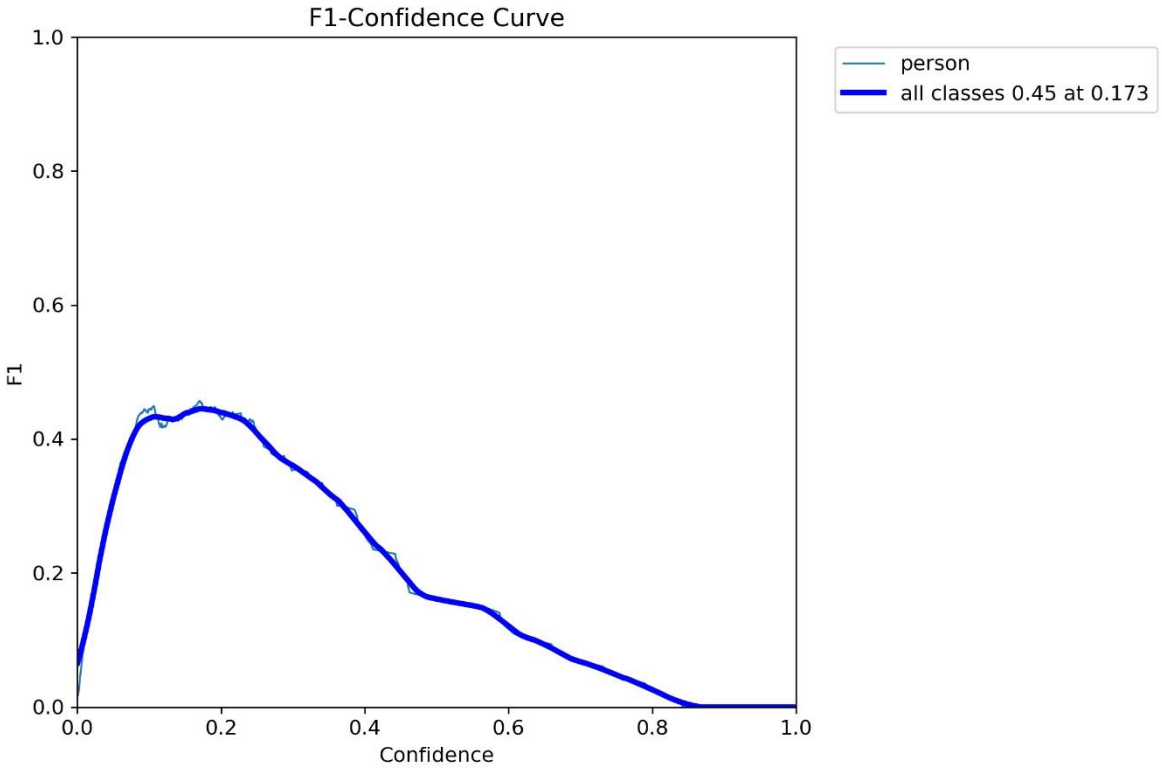
Calculated by taking the average precision over multiple Intersection over Union (IoU) thresholds. It provides a comprehensive evaluation of the model's performance across different detection challenges.

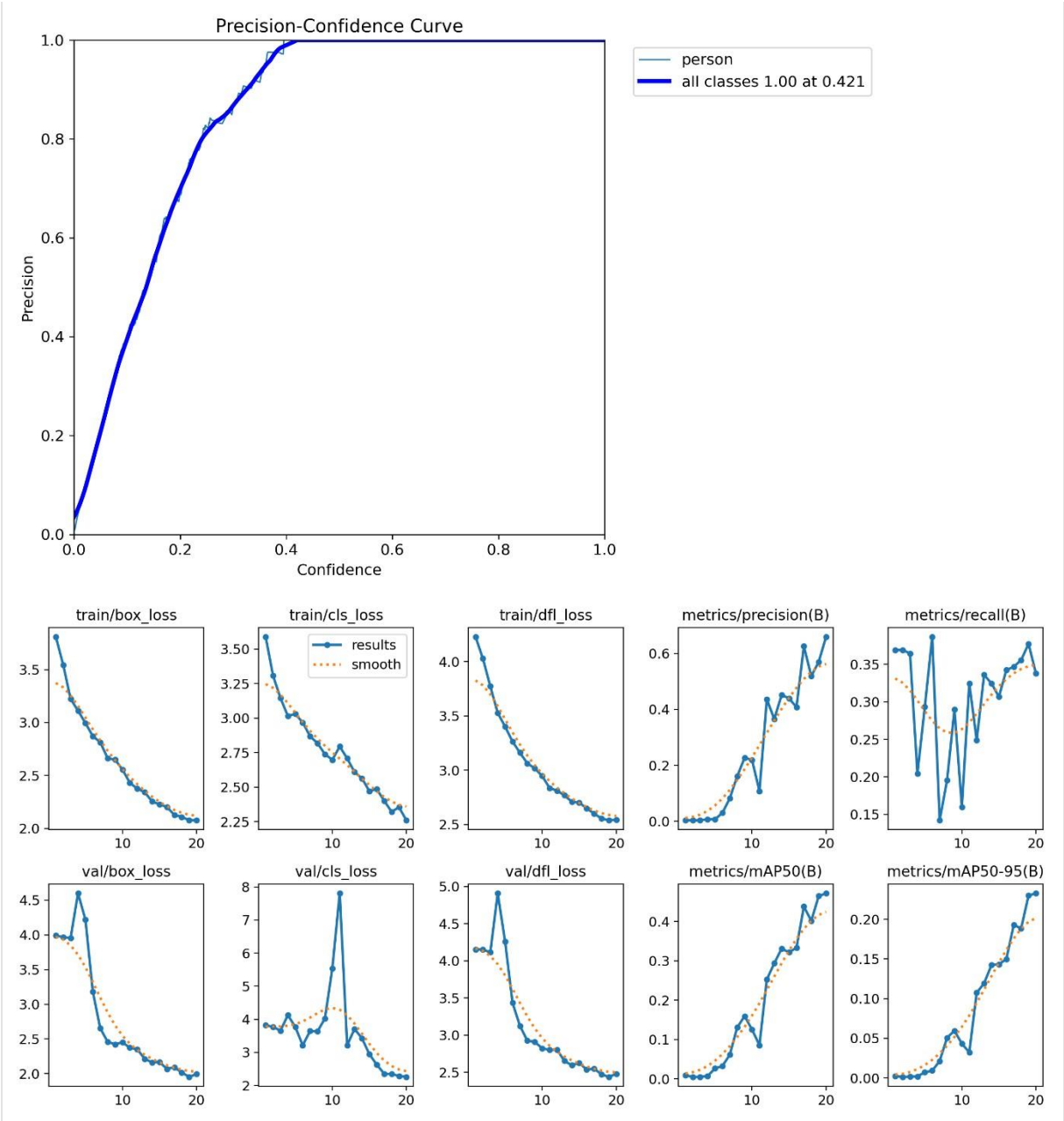
5. Results and Analysis

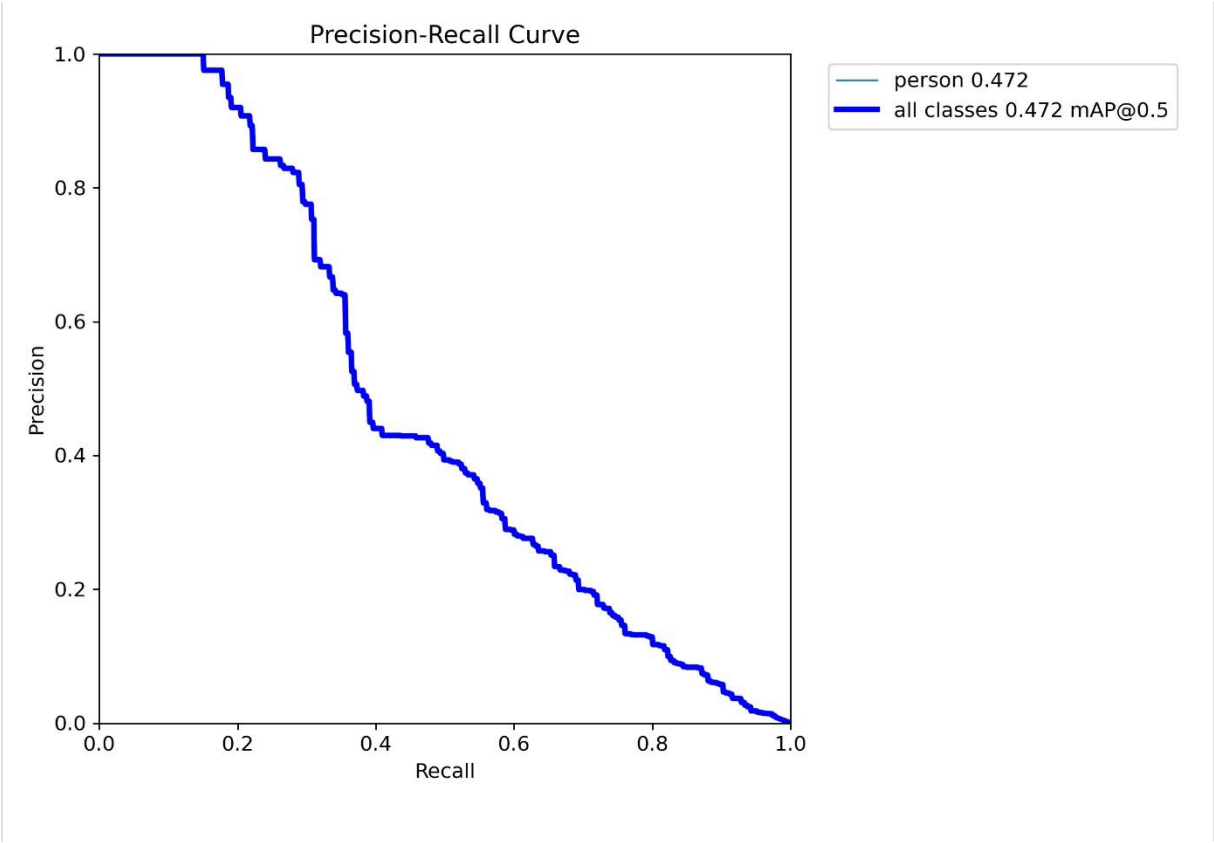
Person Detection Model

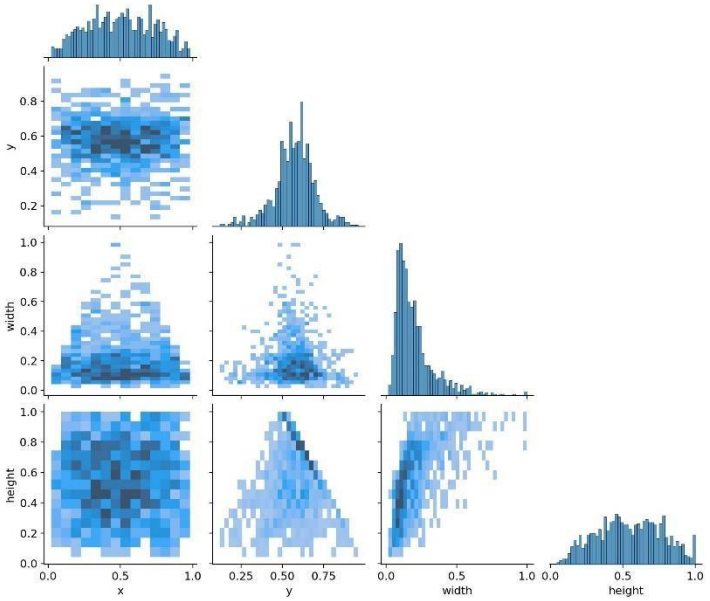


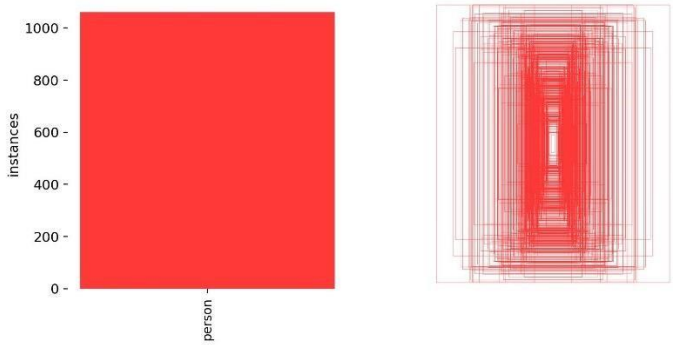

Confusion Matrix Normalized
person
background
Predicted
0.27
1.00
0.73
person
background
True
1.0
0.8
0.6
0.4
0.2
0.0

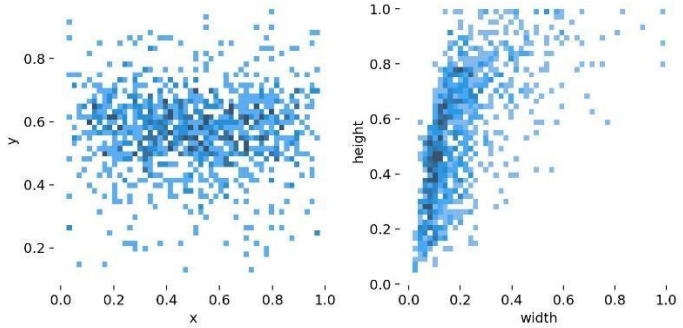

F1-Confidence Curve
F1
Confidence
0.0
0.2
0.4
0.6
0.8
1.0
person
all classes 0.45 at 0.173


Precision-Confidence Curve
person
all classes 1.00 at 0.421
Precision
Confidence
train/box_loss
train/cls_loss
results
smooth
train/dfl_loss
metrics/precision(B)
metrics/recall(B)
val/box_loss
val/cls_loss
val/dfl_loss
metrics/mAP50(B)
metrics/mAP50-95(B)

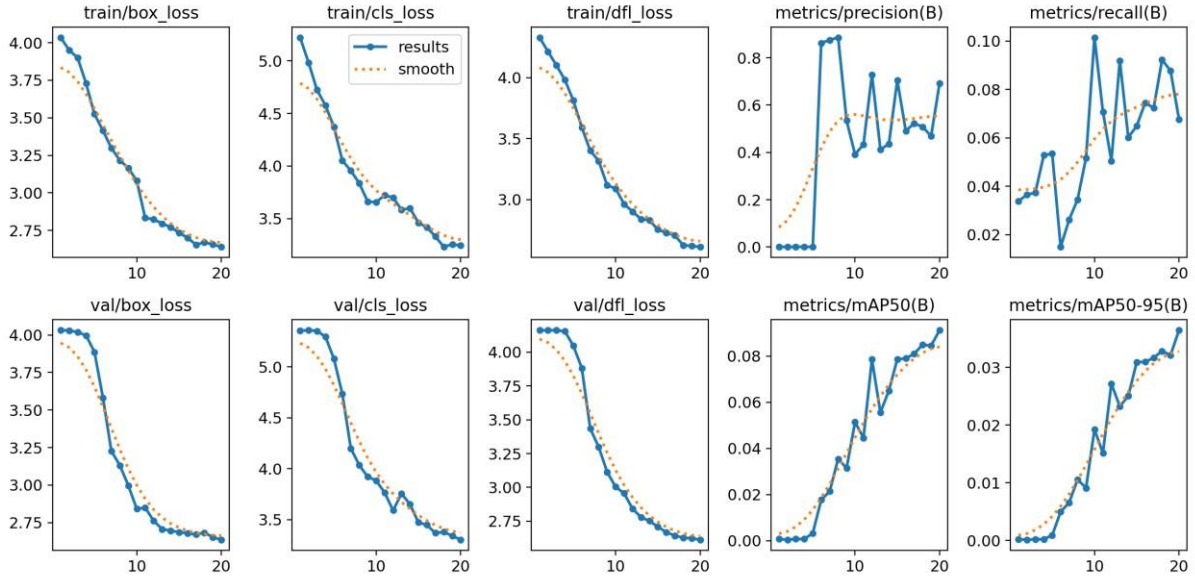

Precision-Recall Curve
Precision
Recall
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
person 0.472
all classes 0.472 mAP@0.5

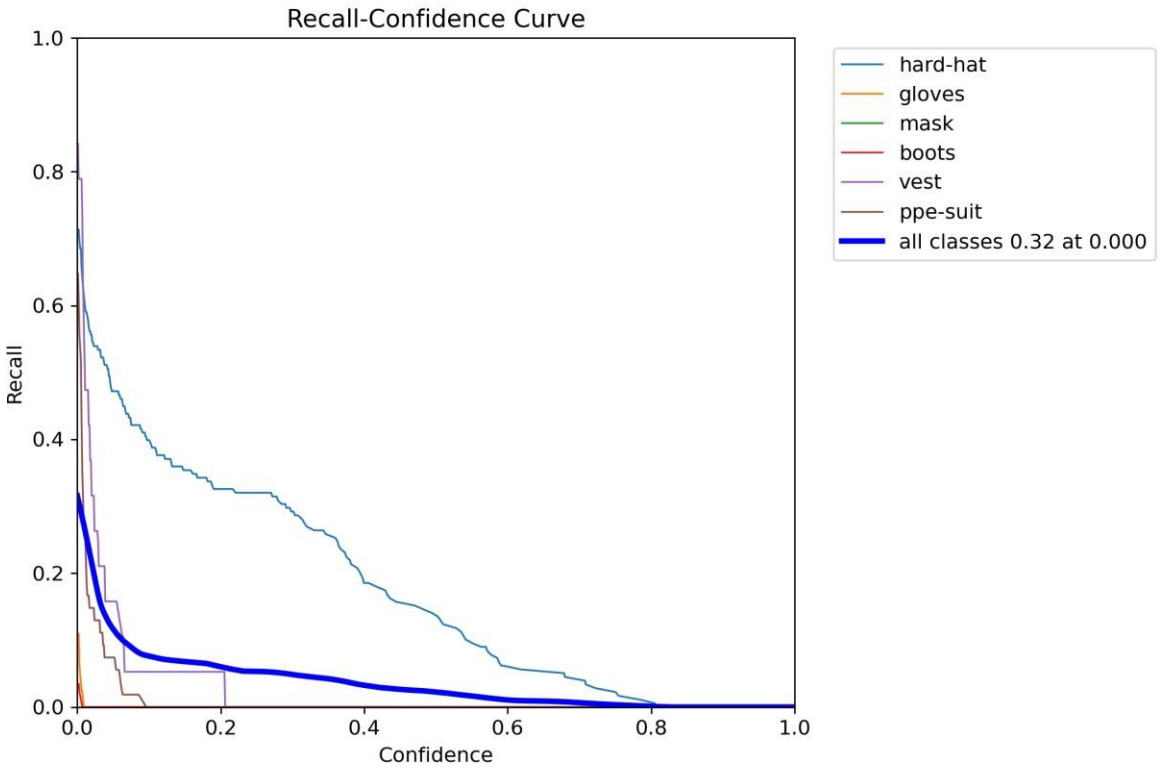

x
y
width
height

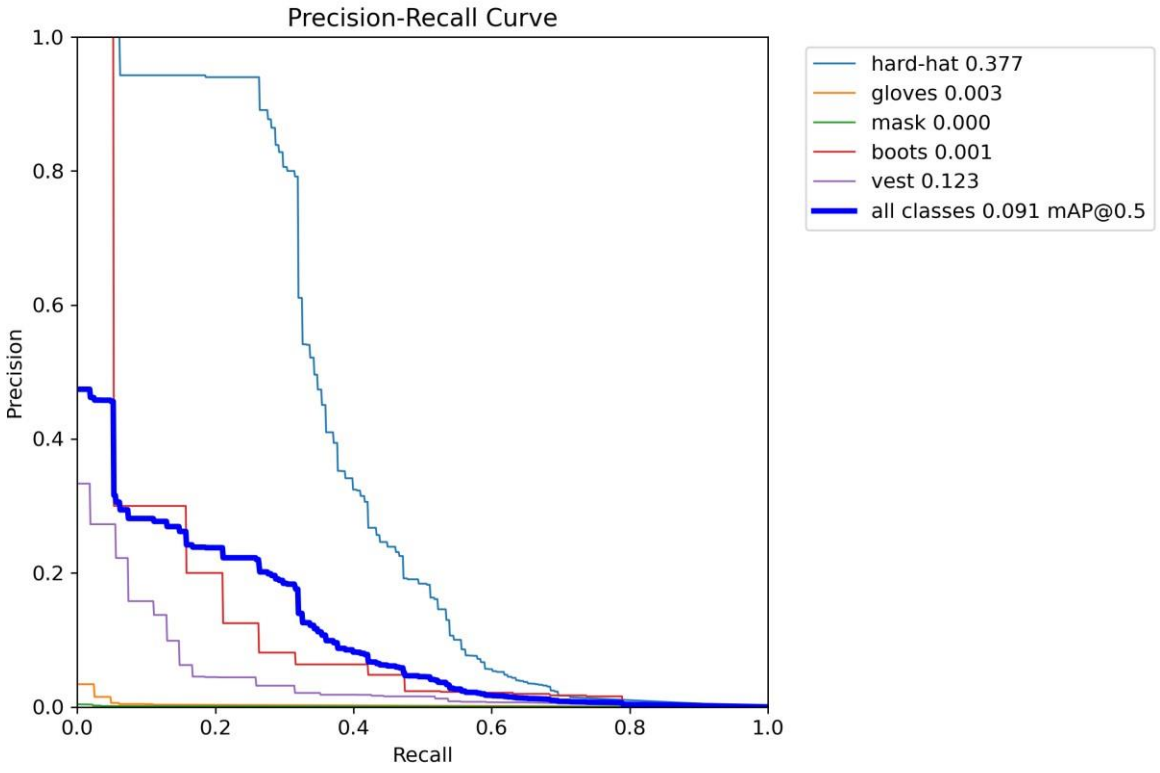

instances
person

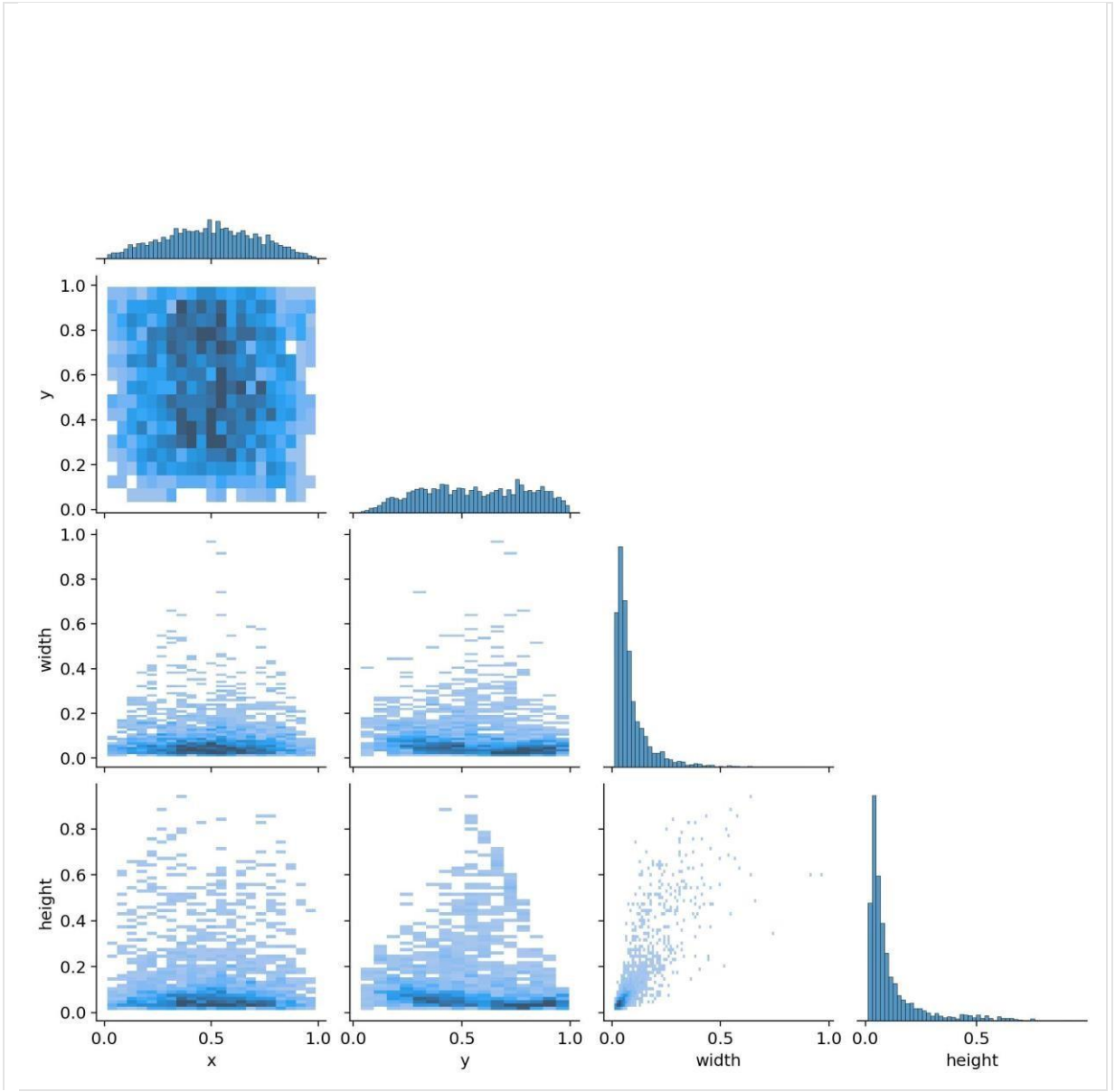

y
x
height
width

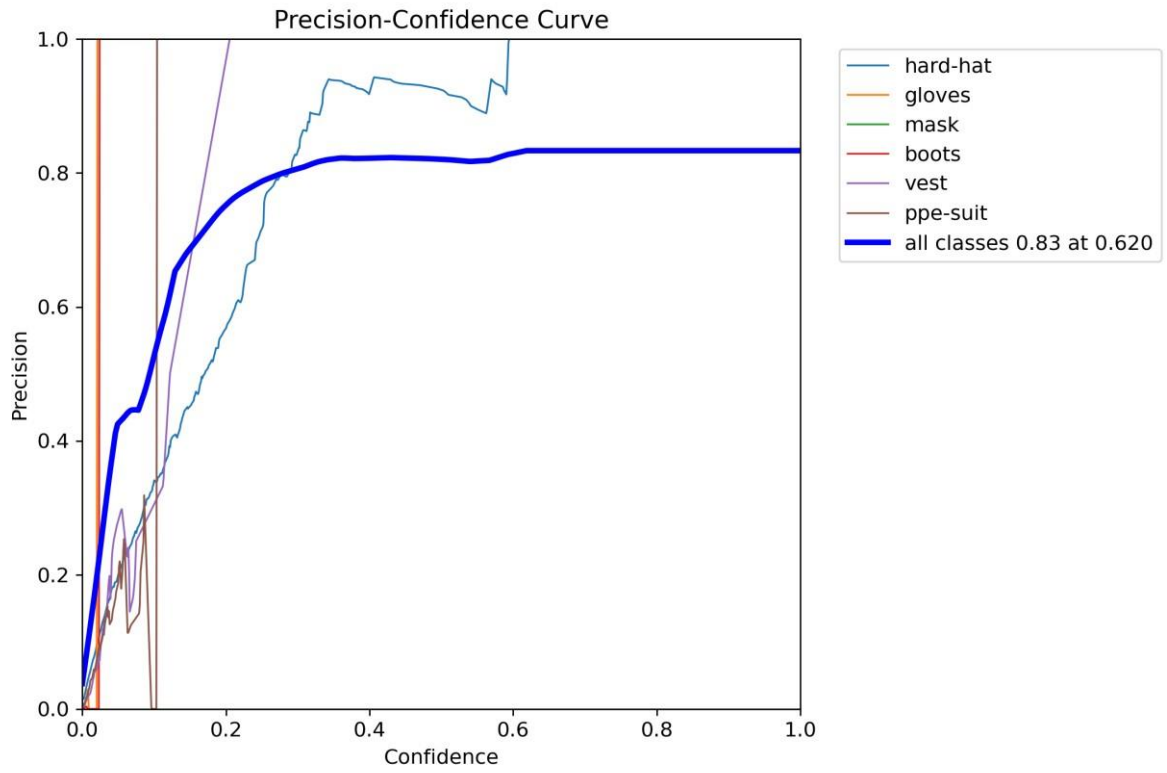
PPE Detection Model

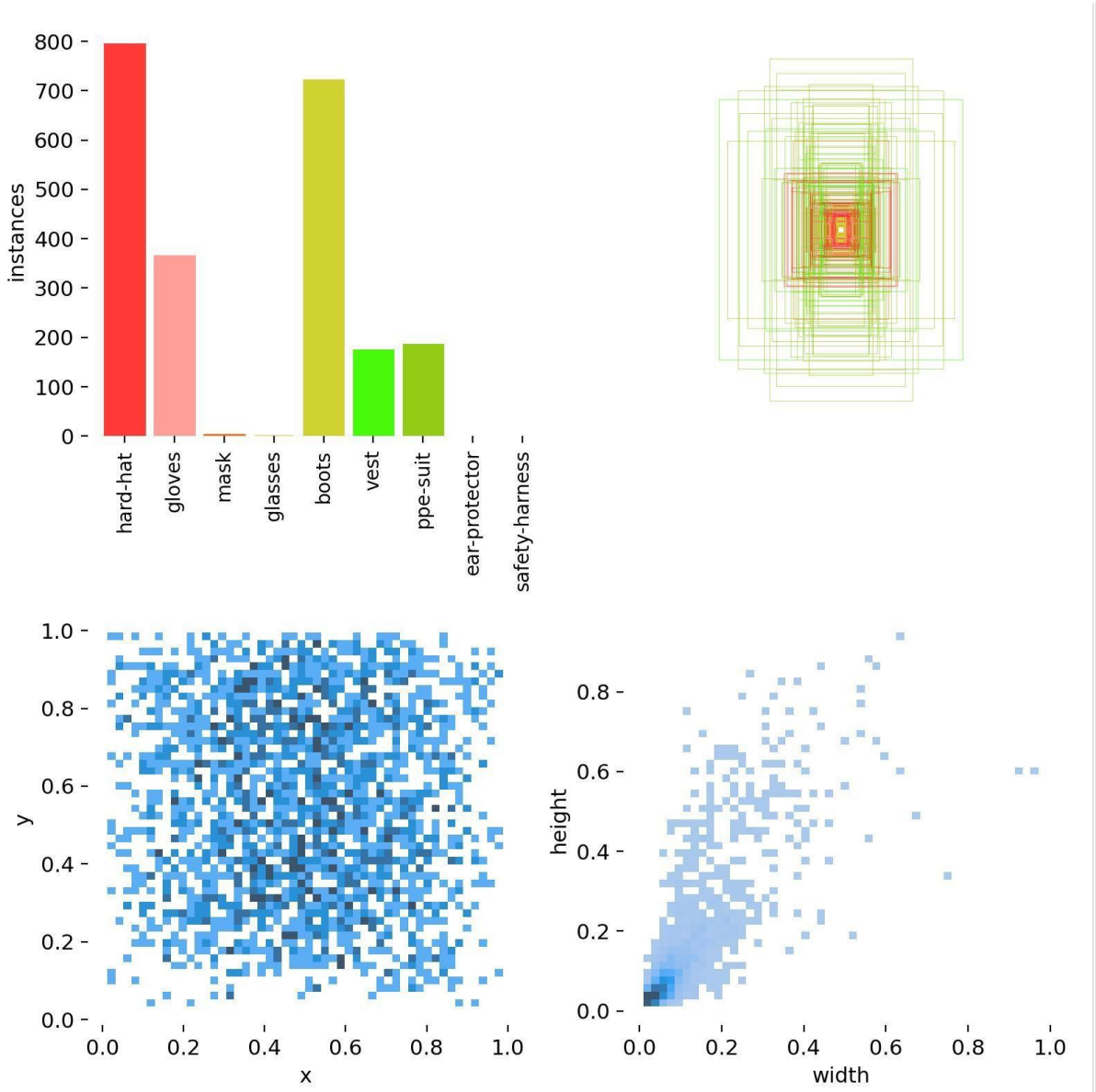


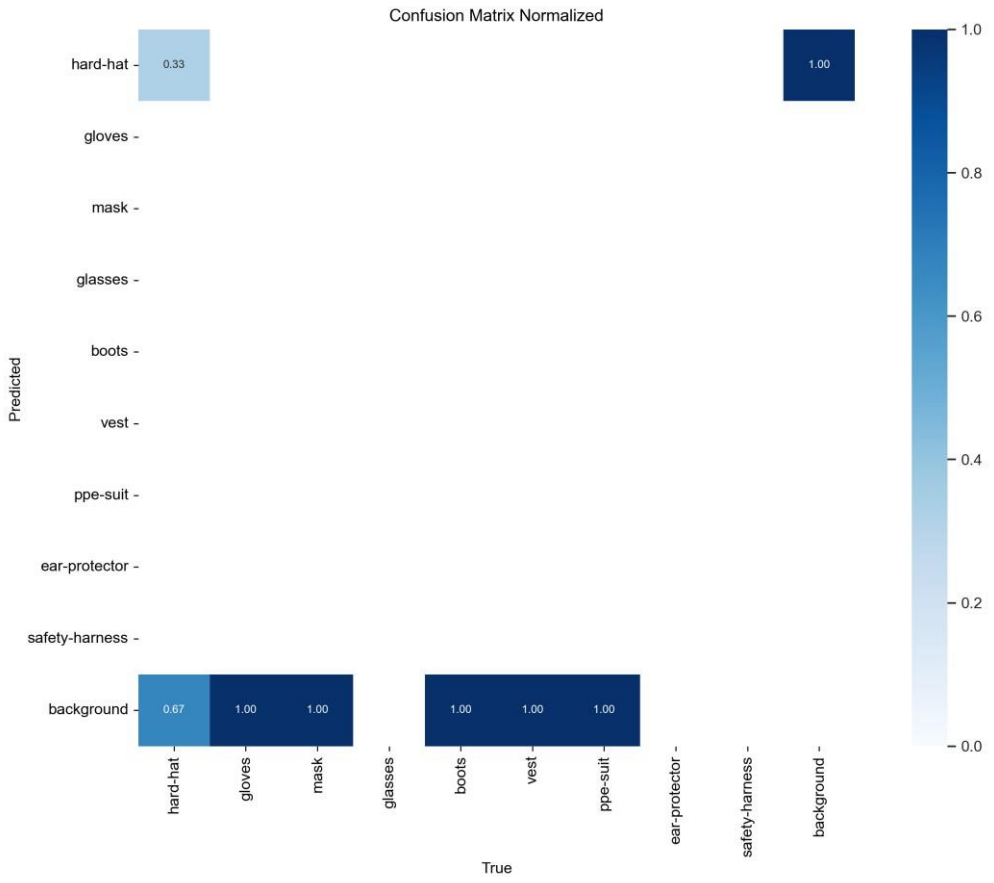

Recall-Confidence Curve
Recall
Confidence
0.0
0.2
0.4
0.6
0.8
1.0
hard-hat
gloves
mask
boots
vest
ppe-suit
all classes 0.32 at 0.000

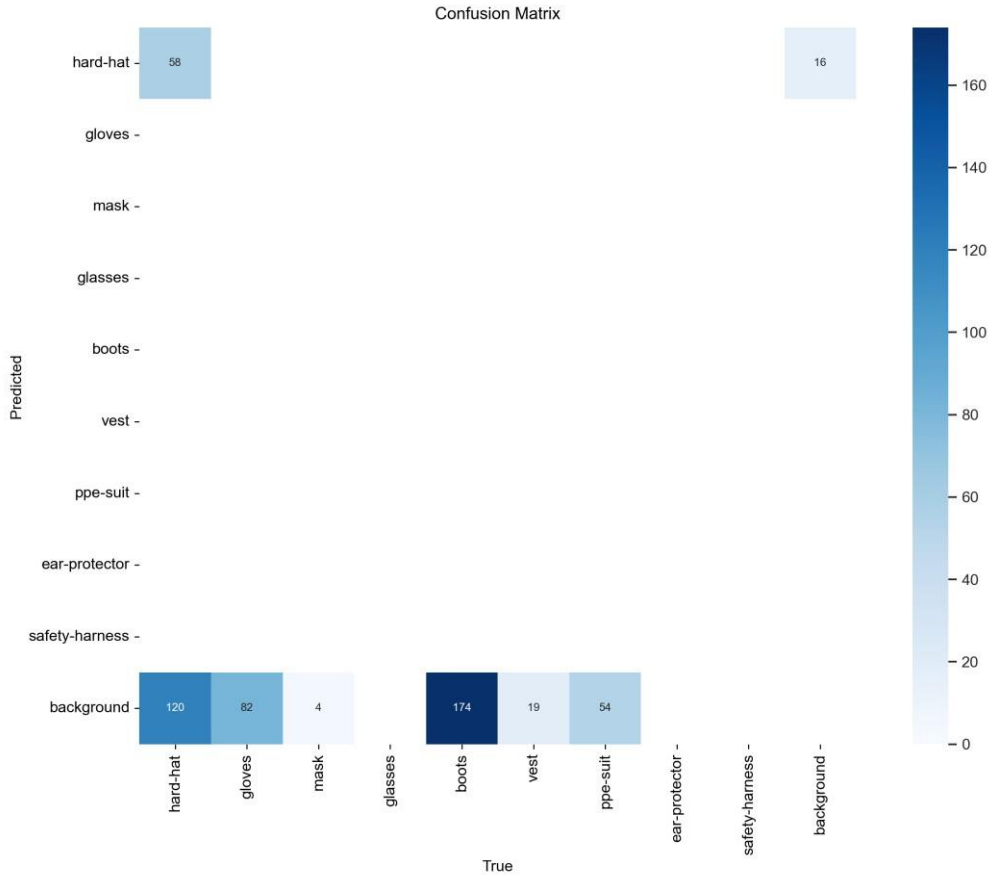

Precision-Recall Curve
Precision
Recall
0.0
0.2
0.4
0.6
0.8
1.0
hard-hat 0.377
gloves 0.003
mask 0.000
boots 0.001
vest 0.123
all classes 0.091 mAP@0.5

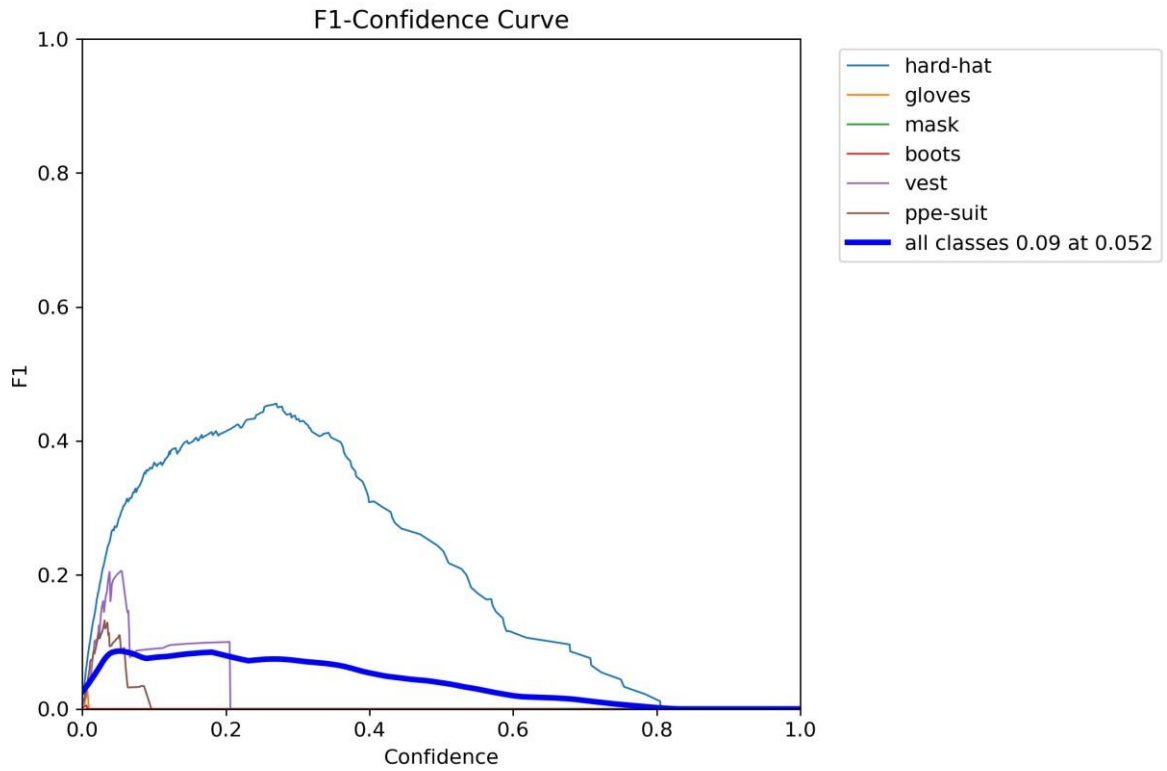

x
y
width
height
0.0
0.2
0.4
0.6
0.8
1.0
0.5


Precision-Confidence Curve
Precision
Confidence
0.0
0.2
0.4
0.6
0.8
1.0
hard-hat
gloves
mask
boots
vest
ppe-suit
all classes 0.83 at 0.620


instances
800
700
600
500
400
300
200
100
0
hard-hat
gloves
mask
glasses
boots
vest
ppe-suit
ear-protector
safety-harness
y
x
0.0
0.2
0.4
0.6
0.8
1.0
height
width

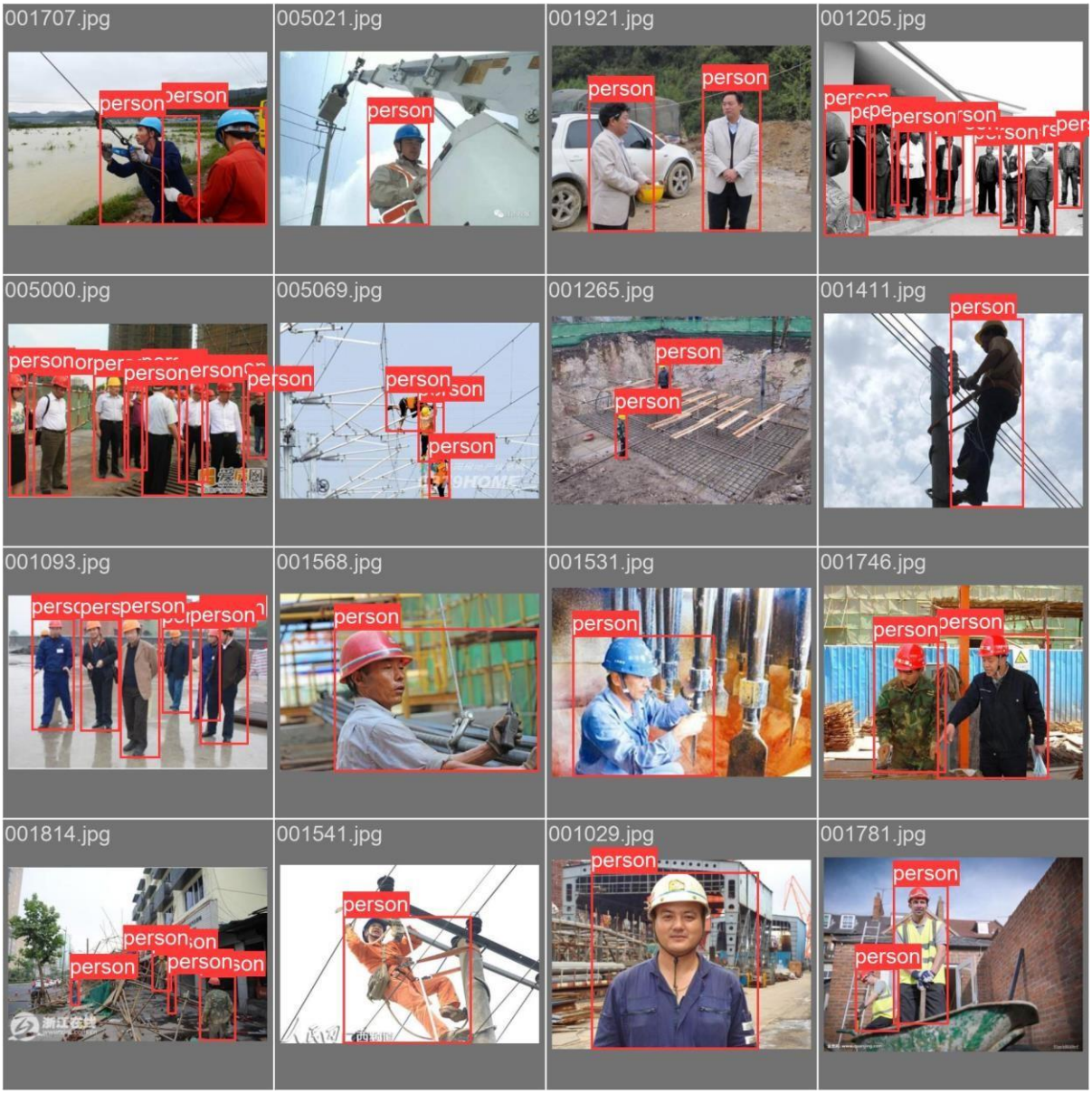

Confusion Matrix Normalized
hard-hat
gloves
mask
glasses
boots
vest
ppe-suit
ear-protector
safety-harness
background
Predicted
True
0.33
1.00
0.67
1.00
1.00
1.00
1.00
1.00
1.0
0.8
0.6
0.4
0.2
0.0


Confusion Matrix
hard-hat
gloves
mask
glasses
boots
vest
ppe-suit
ear-protector
safety-harness
background
Predicted
True
58
16
120
82
4
174
19
54
160
140
120
100
80
60
40
20
0


F1-Confidence Curve
1.0
0.8
0.6
0.4
0.2
0.0
F1
0.0
0.2
0.4
0.6
0.8
1.0
Confidence
hard-hat
gloves
mask
boots
vest
ppe-suit
all classes 0.09 at 0.052

6. Conclusion

RESULT IMPLEMENTATION OF PERSON IDENTIFICATION MODEL



RESULT IMPLEMENTATION OF PPE MODEL

7. References

https://docs.ultralytics.com/usage/python/