工业人工智能技术

基于深度学习的目标检测

李新

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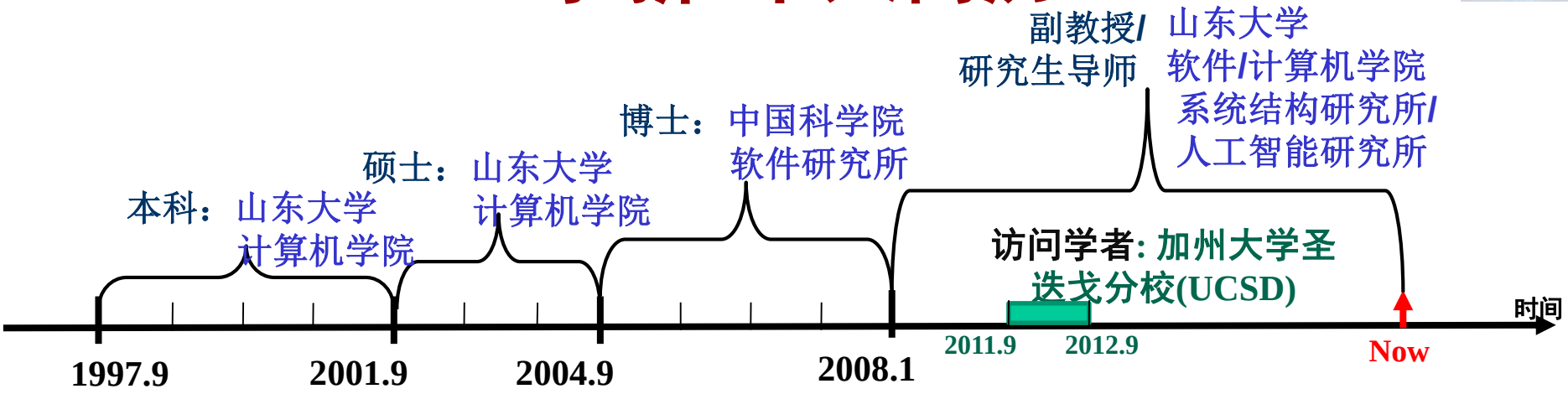
李新 个人简历



- 研究方向
  - 目标检测与跟踪
  - 无人机智能巡检
  - 大数据处理

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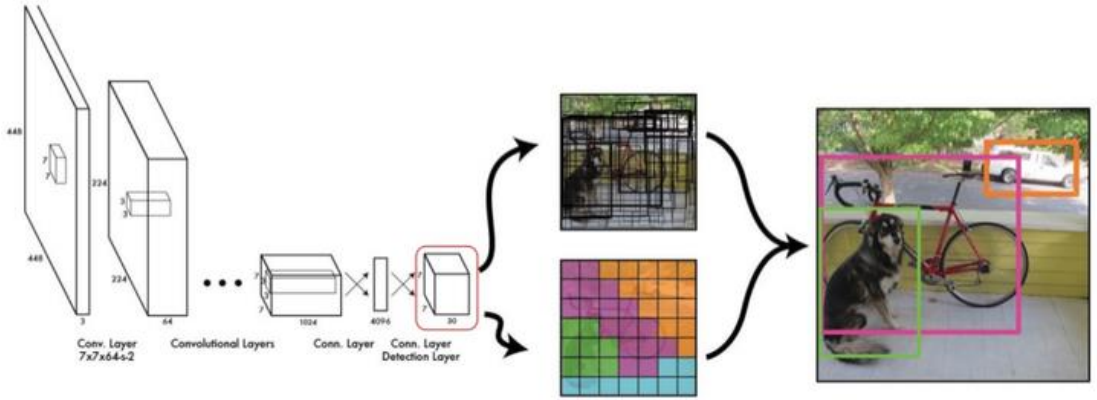
单阶段(1-stage)检测模型代表作：Yolo

单阶段模型没有中间的区域检出过程，直接从图片获得预测结果，也被成为Region-free方法。



1.准备数据：将图片缩放，划分为等分的网格，每个网格按跟Ground Truth的IoU分配到所要预测的样本。
2.卷积网络：由GoogleNet更改而来，每个网格对每个类别预测一个条件概率值，并在网格基础上生成B个box，每个box预测五个回归值，四个表征位置，第五个表征这个box含有物体（注意不是某一类物体）的概率和位置的准确程度（由IoU表示）；
3.后处理：使用NMS（Non-Maximum Suppression，非极大抑制）过滤得到最后的预测框。

YOLO相比两阶段方法，其速度优势明显。但YOLO本身也存在一些问题，如划分网格较为粗糙，每个网格生成的box个数等限制了对小尺度物体和相近物体的检测。

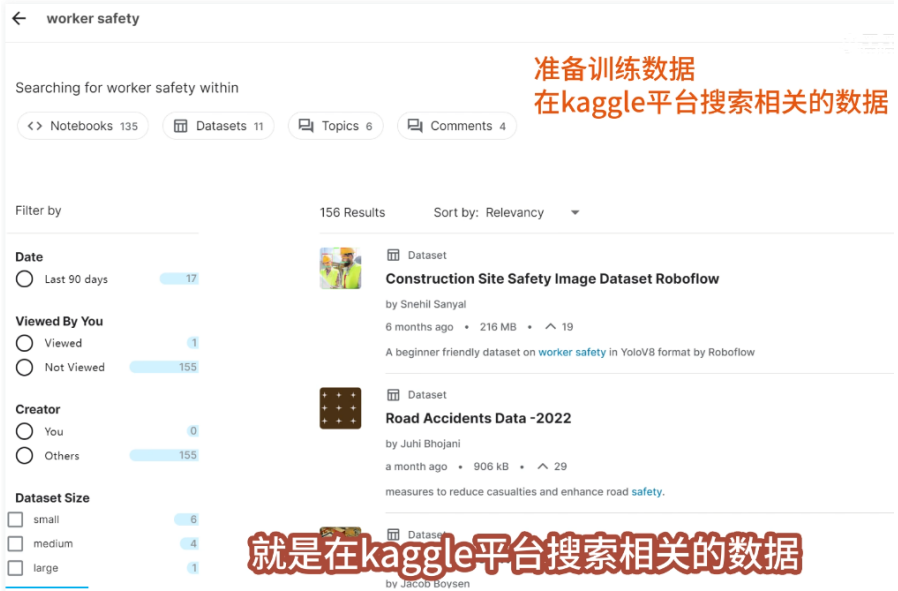
论文链接：You Only Look Once: Unified, Real-Time Object Detection

1. 准备训练数据

➢ 在kaggle平台(需翻墙)搜相关数据

kaggle

搜索Safety Helmet或者 Worker safety



https://github.com/njvisionpower/Safety-Helmet-Wearing-Dataset

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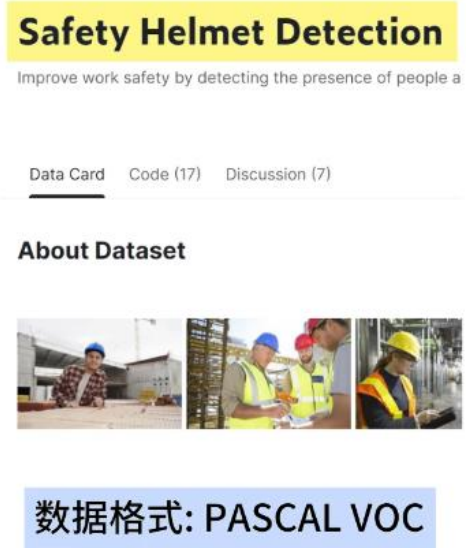
搜索Safety Helmet或者 Worker safety

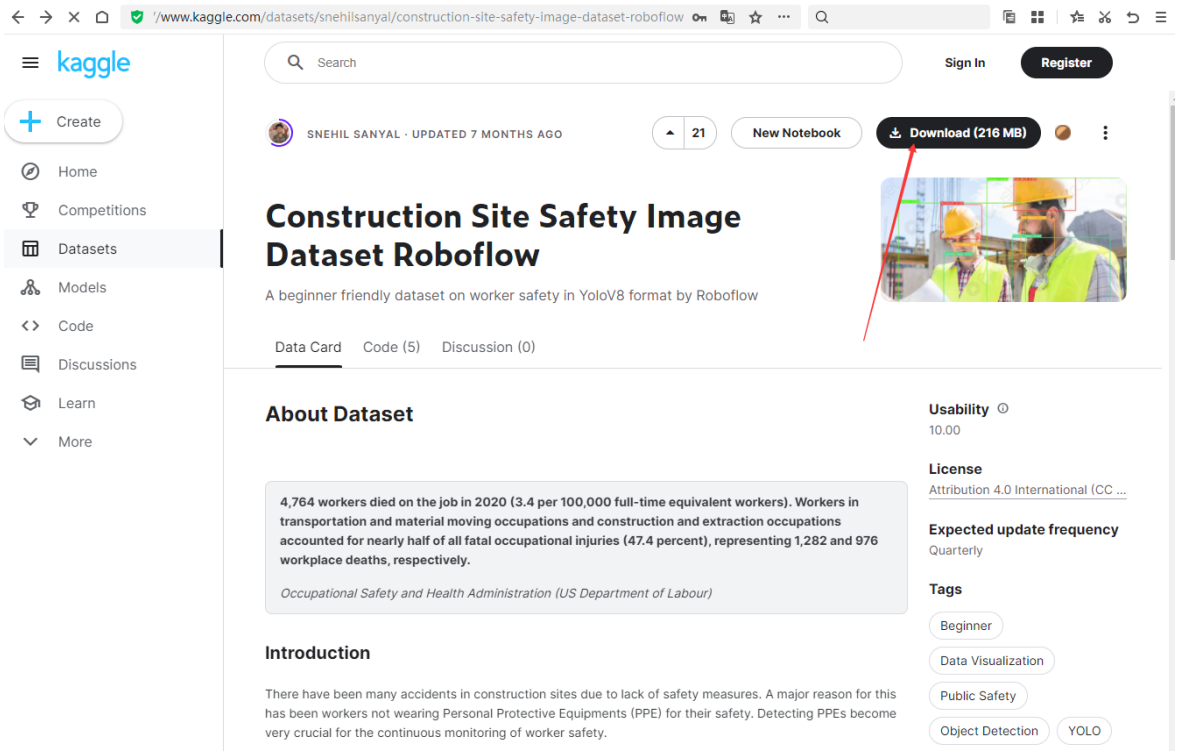


数据格式: PASCAL VOC

数据格式YoloV8，可直接使用

1. 准备训练数据

- 在kaggle平台(需翻墙)下载数据



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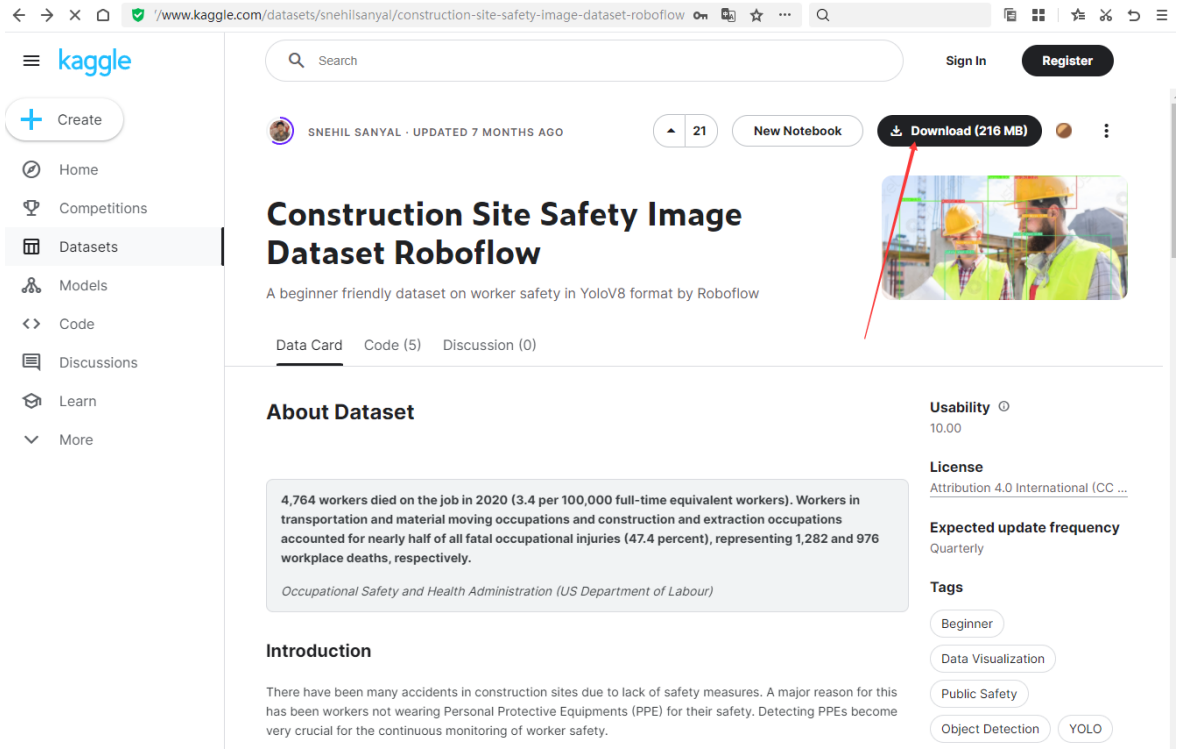
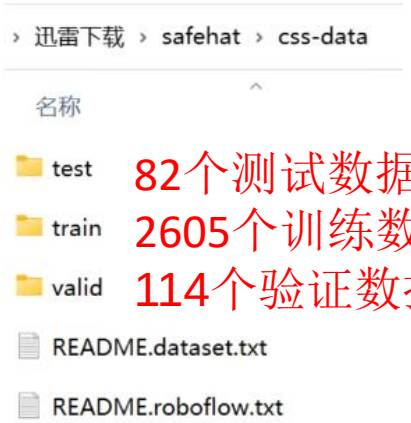
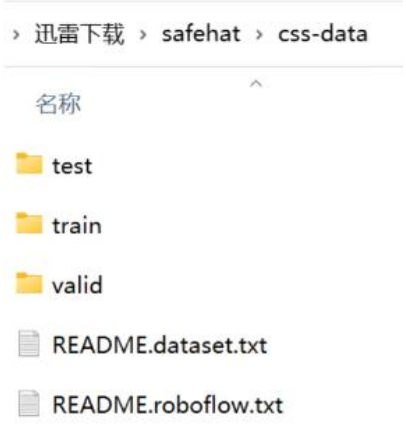




82个测试数据
2605个训练数据
114个验证数据

2. 训练数据

2605个训练数据



train/image保存了图片数据

train/labels保存了数据的标记结果

2. 训练数据

数据图片

01094_jpg.rf.15d2452cfbd2f25016ddb1bb90f0e19a.txt

1	0	0.4984375 0.1109375 0.021875 0.0625
2	0	0.41640625 0.1328125 0.0578125 0.0546875
3	3	0.41640625 0.18671875 0.025 0.0296875
4	7	0.39609375 0.2953125 0.1125 0.2015625
5	7	0.48828125 0.2703125 0.0421875 0.184375
6	5	0.48515625 0.30546875 0.0484375 0.4484375
7	5	0.4078125 0.315625 0.1375 0.428125
8	8	0.6828125 0.14921875 0.346875 0.2984375
9	8	0.534375 0.21171875 0.05 0.1578125
10	3	0.07578125 0.9703125 0.0828125 0.059375
11	0	0.0859375 0.83671875 0.171875 0.2359375
12	5	0.1375 0.85703125 0.275 0.2859375
13	7	0.609375 0.76484375 0.2 0.4703125
14	5	0.68046875 0.76484375 0.3421875 0.4703125

标记数据

- txt标记文件中每一行表示一个目标物体类别序号和位置

2. 训练数据

width = 0.021 * image_width

height = 0.062 * mage_height

数据图片

01094_jpg.rf.15d2452cfbd2f25016ddb1bb90f0e19a.txt

```
1  0 0.4984375 0.1109375 0.021875 0.0625
2  0 0.41640625 0.1328125 0.0578125 0.0546875
3  3 0.41640625 0.18671875 0.025 0.0296875
4  7 0.3
5  7 0.4                                          75
6  5 0.4                                          1375
7  5 0.4
8  8 0.6                                          75
9  8 0.5
10 3 0.0                                          75
11 0 0.0                                          75
12 5 0.1
13 7 0.609375 0.76484375 0.2 0.4703125
14 5 0.68046875 0.76484375 0.3421875 0.4703125
```

class_id: 类别编号

x_center: 边界框中心点x坐标

y_center: 边界框中心点y坐标

width: 边界框的宽度

height: 边界框的高度

标记数据

- 数据只有2605张图片，包括20000多个标记结果

3. 搭建环境

```
(base) C:\Users\49034>conda create -n safehat python=3.10
Collecting package metadata (current_repodata.json): done
Solving environment: done
```

```
(base) C:\Users\49034>activate safehat

(safehat) C:\Users\49034>pip install ultralytics
```

创建环境并安装python: conda create -n safehat python=3.10

激活环境: activate safehat

安装YOLO: pip install ultralytics

3. 搭建环境

safehat.yaml

```yaml
# 模型训练时使用的yaml配置文件。该文件说明了数据的地址和待训练的类别
# 配置三个路径，分别对应训练数据、验证数据、测试数据的地址

# 训练数据用于模型的训练
train: C:\Users\49034\Desktop\yolo\safehat\data\train\images\
# 验证数据用于模型训练过程中的评估和参数调试
val: C:\Users\49034\Desktop\yolo\safehat\data\valid\images\
# 测试数据用于模型完成训练后的测试
test: C:\Users\49034\Desktop\yolo\safehat\data\test\images\

# number of classes
nc: 10

# class names
#names: ['0', '1', '2', '3', '4', '5', '6', '7', '8', '9']
#Hardhat - 安全帽
#Mask - 口罩
#NO-Hardhat - 无安全帽
#NO-Mask - 无口罩
#NO-Safety Vest - 无安全背心
#Person - 人
#Safety Cone - 安全锥
#Safety Vest - 安全背心
#machinery - 机械(挖掘机)
#vehicle - 车辆
names: [Hardhat, Mask, NO-Hardhat, NO-Mask, NO-Safety Vest, Person, Safety Cone, Safety Vest, machinery, veh

```

3. 训练

yolo_train.py

```python
from ultralytics import YOLO #导入Yolo模块

# 加载yolov8的预训练模型，这个模型是yolov8使用了coco数据集训练的通用目标检测模型，
# 我们将它作为基础模型，在该模型的基础上，训练安全帽模型
model = YOLO('yolov8n.pt') # 用于加载模型

# 训练用户自定义的数据集，数据的配置保存在safehat.yaml中，epochs等于100表示100轮迭代
model.train(data='safehat.yaml', epochs=100)

# 使用验证集验证效果
model.val()
```

2. 训练文件

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model.train(data='safehat.yaml',epochs=100)

# 使用验证集验证效果
model.val()
```

```
(safehat) C:\Users\49034\Desktop\yolo\safehat>python yolo_train.py
Ultralytics YOLOv8.0.170  Python-3.10.12 torch-2.0.1+cpu CPU (13th Gen Intel Core(TM) i9-13900H)
engine\trainer: task=detect, mode=train, model=yolov8n.pt, data=safehat.yaml, epochs=100, patience=50
=False, device=None, workers=8, project=None, name=None, exist_ok=False, pretrained=True, optimizer=a
ls=False, rect=False, cos_lr=False, close_mosaic=10, resume=False, amp=True, fraction=1.0, profile=Fa
out=0.0, val=True, split=val, save_json=False, save_hybrid=False, conf=None, iou=0.7, max_det=300, ha
e, save_txt=False, save_conf=False, save_crop=False, show_labels=True, show_conf=True, vid_stride=1,
augment=False, agnostic_nms=False, classes=None, retina_masks=False, boxes=True, format=torchscript,
 simplify=False, opset=None, workspace=4, nms=False, lr0=0.01, lrf=0.01, momentum=0.937, weight_decay
_bias_lr=0.1, box=7.5, cls=0.5, dfl=1.5, pose=12.0, kobj=1.0, label_smoothing=0.0, nbs=64, hsv_h=0.01
ale=0.5, shear=0.0, perspective=0.0, flipud=0.0, fliplr=0.5, mosaic=1.0, mixup=0.0, copy_paste=0.0, c
in3
Overriding model.yaml nc=80 with nc=10

                   from  n    params  module                                       arguments
  0                  -1  1       464  ultralytics.nn.modules.conv.Conv             [3, 16, 3, 2]
  1                  -1  1      4672  ultralytics.nn.modules.conv.Conv             [16, 32, 3, 2]
  2                  -1  1      7360  ultralytics.nn.modules.block.C2f             [32, 32, 1, True]
  3                  -1  1     18560  ultralytics.nn.modules.conv.Conv             [32, 64, 3, 2]
  4                  -1  2     49664  ultralytics.nn.modules.block.C2f             [64, 64, 2, True]
  5                  -1  1     73984  ultralytics.nn.modules.conv.Conv             [64, 128, 3, 2]
  6                  -1  2    197632  ultralytics.nn.modules.block.C2f             [128, 128, 2, True
  7                  -1  1    295424  ultralytics.nn.modules.conv.Conv             [128, 256, 3, 2]
  8                  -1  1    460288  ultralytics.nn.modules.block.C2f             [256, 256, 1, True
  9                  -1  1    164608  ultralytics.nn.modules.block.SPPF            [256, 256, 5]
 10                  -1  1                                                         [None, 2, 'nearest
 11            [-1, 6]  1                                                         [1]
```


ultralytics yolov8版本

yolo_test.py

```python
from ultralytics import YOLO #在代码中导入yolo模块

# 导入训练好的模型best.pt
model = YOLO('best.pt')

# 随意找一些测试数据
# 图片数据和视频数据都可以，直接将数据传入接口就可以了
model.predict('01094_jpg.rf.15d2452cfbd2f25016ddb1bb90f0e19a.jpg', save=True)
model.predict('indianworkers.mp4', save=True)

# 自己构造一些数据
# 在识别自己构造的数据时，传入了classes = [0, 2],
# 代表只输出0和2，也就是安全帽是否佩戴这两个类别
# line_width = 30表示指定识别框的字体大小为30
model.predict('myself1.jpg', save=True, classes = [0, 2], line_width = 30)
model.predict('myself2.jpg', save=True, classes = [0, 2], line_width = 30)
model.predict('myself1.MP4', save=True, classes = [0, 2], line_width = 30)
model.predict('myself2.MP4', save=True, classes = [0, 2], line_width = 30)
```

```
(safehat) C:\Users\49034\Desktop\yolo\safehat>python yolo_test.py

image 1/1 C:\Users\49034\Desktop\yolo\safehat\01094_jpg.rf.15d2452cfbd2f25016ddb1bb90f0e19a.jpg: 640x640 4 Hardhats, 2 NO-Masks, 5 Persons, 3 Safety Vests,
2 machinerys, 141.5ms
Speed: 2.5ms preprocess, 141.5ms inference, 6.0ms postprocess per image at shape (1, 3, 640, 640)
Results saved to runs\detect\predict


WARNING  inference results will accumulate in RAM unless `stream=True` is passed, causing potential out-of-memory
errors for large sources or long-running streams and videos. See https://docs.ultralytics.com/modes/predict/ for help.

Example:
    results = model(source=..., stream=True)  # generator of Results objects
    for r in results:
        boxes = r.boxes  # Boxes object for bbox outputs
        masks = r.masks  # Masks object for segment masks outputs
        probs = r.probs  # Class probabilities for classification outputs

video 1/1 (1/648) C:\Users\49034\Desktop\yolo\safehat\indianworkers.mp4: 384x640 3 Hardhats, 2 Persons, 4 Safety Vests, 2 machinerys, 85.3ms
video 1/1 (2/648) C:\Users\49034\Desktop\yolo\safehat\indianworkers.mp4: 384x640 3 Hardhats, 2 Persons, 4 Safety Vests, 2 machinerys, 86.0ms
video 1/1 (3/648) C:\Users\49034\Desktop\yolo\safehat\indianworkers.mp4: 384x640 3 Hardhats, 2 Persons, 3 Safety Vests, 2 machinerys, 78.1ms
video 1/1 (4/648) C:\Users\49034\Desktop\yolo\safehat\indianworkers.mp4: 384x640 3 Hardhats, 2 Persons, 2 Safety Vests, 2 machinerys, 76.2ms
video 1/1 (5/648) C:\Users\49034\Desktop\yolo\safehat\indianworkers.mp4: 384x640 3 Hardhats, 2 Persons, 2 Safety Vests, 2 machinerys, 73.7ms
video 1/1 (6/648) C:\Users\49034\Desktop\yolo\safehat\indianworkers.mp4: 384x640 3 Hardhats, 2 Persons, 4 Safety Vests, 2 machinerys, 70.5ms
video 1/1 (7/648) C:\Users\49034\Desktop\yolo\safehat\indianworkers.mp4: 384x640 3 Hardhats, 2 Persons, 4 Safety Vests, 2 machinerys, 74.6ms
video 1/1 (8/648) C:\Users\49034\Desktop\yolo\safehat\indianworkers.mp4: 384x640 3 Hardhats, 2 Persons, 3 Safety Vests, 2 machinerys, 71.4ms
video 1/1 (9/648) C:\Users\49034\Desktop\yolo\safehat\indianworkers.mp4: 384x640 2 Hardhats, 2 Persons, 3 Safety Vests, 2 machinerys, 77.7ms
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video 1/1 (11/648) C:\Users\49034\Desktop\yolo\safehat\indianworkers.mp4: 384x640 2 Hardhats, 2 Persons, 2 Safety Vests, 3 machinerys, 83.8ms
video 1/1 (12/648) C:\Users\49034\Desktop\yolo\safehat\indianworkers.mp4: 384x640 2 Hardhats, 2 Persons, 3 Safety Vests, 2 machinerys, 1 vehicle, 81.6ms
video 1/1 (13/648) C:\Users\49034\Desktop\yolo\safehat\indianworkers.mp4: 384x640 2 Hardhats, 2 Persons, 4 Safety Vests, 3 machinerys, 84.1ms
video 1/1 (14/648) C:\Users\49034\Desktop\yolo\safehat\indianworkers.mp4: 384x640 3 Hardhats, 2 Persons, 3 Safety Vests, 3 machinerys, 84.0ms
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```
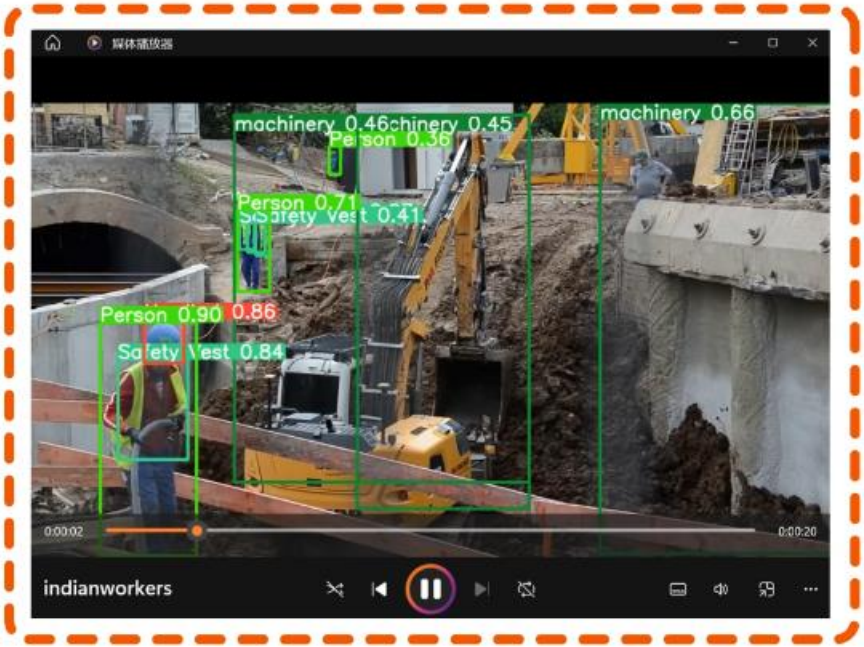


识别结果会保存在当前目录下的runs/detect/predict中

runs/detect/predict中


machinery 0.95
Hardhat 0.91
machinery 0.45
Safety Vest 0.91
Person 0.95
Hardhat 0.84
Hardhat 0.38


媒体播放器
machinery 0.46
machinery 0.45
Person 0.36
machinery 0.66
Person 0.71
Safety Vest 0.41
Person 0.90
0.86
Safety Vest 0.84
0:00:02
0:00:20
indianworkers

谢 谢！