

## LAMPIRAN A *Listing Code Program*

```
"""trt_yolo.py

This script demonstrates how to do real-time object detection with
TensorRT optimized YOLO engine.
"""

import os
import time
import argparse
import imutils

import cv2
import pycuda.autotinit # This is needed for initializing CUDA driver

import numpy as np
from scipy.spatial import distance as dist

from utils.yolo_classes import get_cls_dict
from utils.camera import add_camera_args, Camera
from utils.display import open_window, set_display, show_fps
from utils.visualization import BBoxVisualization
from utils.yolo_with_plugins import TrtYOLO

WINDOW_NAME = "TrtYOLODemo"

def parse_args():
    """Parse input arguments."""
    desc = (
        "Capture and display live camera video, while doing "
        "real-time object detection with TensorRT optimized "
        "YOLO model on Jetson"
    )
    parser = argparse.ArgumentParser(description=desc)
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parser = add_camera_args(parser)
parser.add_argument(
    "-c",
    "--category_num",
    type=int,
    default=1,
    help="number of object categories [80]",
)
parser.add_argument(
    "-t",
    "--conf_thresh",
    type=float,
    default=0.3,
    help="set the detection confidence threshold",
)
parser.add_argument(
    "-m",
    "--model",
    type=str,
    required=True,
    help=(
        "[yolov3-tiny|yolov3|yolov3-spp|yolov4-tiny|yolov4|"
        "yolov4-csp|yolov4x-mish|yolov4-p5]-[dimension], where
"
        "{dimension} could be either a single number (e.g. "
        "288, 416, 608) or 2 numbers, WxH (e.g. 416x256)"
    ),
)
parser.add_argument(
    "-l",
    "--letter_box",
    action="store_true",
    help="inference with letterboxed image [False]",
)
args = parser.parse_args()
return args

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def loop_and_detect(cam, trt_yolo, conf_th, vis):
    """Continuously capture images from camera and do object
    detection.

    # Arguments
    cam: the camera instance (video source).
    trt_yolo: the TRT YOLO object detector instance.
    conf_th: confidence/score threshold for object detection.
    vis: for visualization.
    """
    full_scrn = False
    fps = 0.0
    tic = time.time()

    while True:
        if cv2.getWindowProperty(WINDOW_NAME, 0) < 0:
            break

        (gr, img) = cam.read()
        if not gr:
            break

        boxes, confs, cls = trt_yolo.detect(img, conf_th)

        # img = vis.draw_bboxes(img, boxes, confs, cls)
        img = show_fps(img, fps)

        results = []
        if len(cls) > 0:
            for i, val in enumerate(cls.astype("int32").flatten()):
                (x_min, y_min) = (boxes[i, 0], boxes[i, 1])
                (x_max, y_max) = (boxes[i, 2], boxes[i, 3])

                w = int(x_max - x_min)
                h = int(y_max - y_min)

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        centerX = int(x_min + (w / 2))
        centerY = int(y_min + (h / 2))

        r = (confs[i], (x_min, y_min, x_max, y_max), (centerX,
centerY))

        # print(r)
        results.append(r)

print(cls)

violate = set()
if len(results) >= 2:
    centroids = np.array([r[2] for r in results])
    # rint(centroids)
    D = dist.cdist(centroids, centroids, metric="euclidean")
    # print(D)

    for i in range(0, D.shape[0]):
        for j in range(i + 1, D.shape[1]):
            # print("%.10f" % D[i,j])

            if D[i, j] < 986:
                violate.add(i)
                violate.add(j)

# print(violate)

for (i, (prob, bbox, centroid)) in enumerate(results):
    (startX, startY, endX, endY) = bbox
    (cX, cY) = centroid
    color = (0, 255, 0)

    if i in violate:
        color = (0, 0, 255)

    cv2.rectangle(img, (startX, startY), (endX, endY), color,

```

2)

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        cv2.circle(img, (cX, cY), 5, color, 1)

text = "Social Distancing Violations: {}".format(len(violate))
cv2.putText(
    img,
    text,
    (10, img.shape[0] - 25),
    cv2.FONT_HERSHEY_SIMPLEX,
    0.85,
    (0, 0, 255),
    3,
)

cv2.imshow(WINDOW_NAME, img)
toc = time.time()
curr_fps = 1.0 / (toc - tic)

# calculate an exponentially decaying average of fps number
fps = curr_fps if fps == 0.0 else (fps * 0.95 + curr_fps *
0.05)

tic = toc
key = cv2.waitKey(1)
if key == 27: # ESC key: quit program
    break
elif key == ord("F") or key == ord("f"): # Toggle fullscreen
    full_scrn = not full_scrn
    set_display(WINDOW_NAME, full_scrn)

def main():
    args = parse_args()
    if args.category_num <= 0:
        raise SystemExit("ERROR: bad category_num (%d)!" %
args.category_num)
    if not os.path.isfile("yolo/%s.trt" % args.model):
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        raise SystemExit("ERROR: file (yolo/%s.trt) not found!" %
args.model)

# cam = Camera(args)
cam = cv2.VideoCapture(args.usb)
if not cam.isOpened():
    raise SystemExit("ERROR: failed to open the input video
file!")

cls_dict = get_cls_dict(args.category_num)
vis = BBoxVisualization(cls_dict)
trt_yolo = TrtYOLO(args.model, args.category_num,
args.letter_box)
open_window(WINDOW_NAME, "Camera TensorRT YOLO Demo",
int(cam.get(3)), int(cam.get(4)))

loop_and_detect(cam, trt_yolo, args.conf_thresh, vis=vis)

cam.release()
cv2.destroyAllWindows()

if __name__ == "__main__":
    main()

```

## LAMPIRAN B Perhitungan

### Pengujian 2 Orang

#### Menghadap Kamera

##### 1. AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{16}{16 + 0} = \frac{16}{16} = 1$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{16}{16 + 1} = \frac{16}{17} = 0.889$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (0.889 \times 1)}{0.889 + 1} = \frac{1.778}{1.889} = 0.941$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{16 + 18}{16 + 0 + 2 + 18} \times 100\% = \frac{34}{36} \times 100\% = 94.444\%$$

##### 2. TIDAK AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{18}{18 + 2} = \frac{18}{20} = 0.9$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{18}{18 + 0} = \frac{18}{18} = 1$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (1 \times 0.9)}{1 + 0.9} = \frac{1.8}{1.9} = 0.947$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{18 + 16}{18 + 2 + 0 + 16} \times 100\% = \frac{34}{36} \times 100\% = 94.444\%$$

#### Menghadap Kanan Kamera

##### 1. AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{17}{17 + 0} = \frac{17}{17} = 1$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{17}{17 + 1} = \frac{17}{18} = 0.944$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (0.944 \times 1)}{0.944 + 1} = \frac{1.888}{1.944} = 0.971$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{17 + 18}{17 + 0 + 1 + 18} \times 100\% = \frac{35}{36} \times 100\% = 97.222\%$$

##### 2. TIDAK AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{18}{18 + 1} = \frac{18}{19} = 0.947$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{18}{18 + 0} = \frac{18}{18} = 1$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (1 \times 0.947)}{1 + 0.947} = \frac{1.894}{1.947} = 0.973$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{18 + 17}{18 + 0 + 1 + 17} \times 100\% = \frac{35}{36} \times 100\% = 97.222\%$$

## Menghadap Kiri Kamera

### 1. AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{16}{16 + 0} = \frac{16}{16} = 1$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{16}{16 + 2} = \frac{16}{18} = 0.889$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (0.889 \times 1)}{0.889 + 1} = \frac{1.778}{1.889} = 0.941$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{16 + 18}{16 + 0 + 1 + 18} \times 100\% = \frac{34}{35} \times 100\% = 94.444\%$$

### 2. TIDAK AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{18}{18 + 2} = \frac{18}{20} = 0.9$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{18}{18 + 0} = \frac{18}{18} = 1$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (1 \times 0.9)}{1 + 0.9} = \frac{1.18}{1.9} = 0.947$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{18 + 16}{18 + 2 + 0 + 16} \times 100\% = \frac{34}{36} \times 100\% = 94.444\%$$

## Menghadap Belakang

### 5. AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{14}{14 + 0} = \frac{14}{14} = 1$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{14}{14 + 4} = \frac{14}{18} = 0.778$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (0.778 \times 1)}{0.778 + 1} = \frac{1.556}{1.778} = 0.875$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{14 + 18}{14 + 0 + 4 + 20} \times 100\% = \frac{32}{36} \times 100\% = 88.889\%$$

### 6. TIDAK AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{18}{18 + 4} = \frac{18}{22} = 0.818$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{18}{18 + 0} = \frac{18}{18} = 1$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (1 \times 0.818)}{1 + 0.818} = \frac{1.636}{1.818} = 0.9$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{18 + 24}{18 + 4 + 0 + 20} \times 100\% = \frac{32}{36} \times 100\% = 88.889\%$$



## Pengujian 3 Orang

### Menghadap Kamera

#### 1. SEMUA AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{10}{10 + 0} = \frac{10}{10} = 1$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{10}{10 + 1} = \frac{10}{11} = 0.909$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (0.909 \times 1)}{0.909 + 1} = \frac{1.818}{1.909} = 0.952$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{10 + 22}{10 + 0 + 1 + 22} \times 100\% = \frac{32}{33} \times 100\% = 96.97\%$$

#### 2. SEMUA TIDAK AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{12}{12 + 2} = \frac{12}{14} = 0.857$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{12}{12 + 0} = \frac{12}{12} = 1$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (1 \times 0.857)}{1 + 0.857} = \frac{1.714}{1.857} = 0.923$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{12 + 25}{12 + 2 + 0 + 25} \times 100\% = \frac{37}{39} \times 100\% = 94.872\%$$

#### 3. 1 AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{13}{13 + 1} = \frac{13}{14} = 0.929$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{13}{13 + 2} = \frac{13}{15} = 0.867$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (0.867 \times 0.929)}{0.867 + 0.929} = \frac{1.611}{1.796} = 0.897$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{13 + 23}{12 + 1 + 2 + 23} \times 100\% = \frac{36}{39} \times 100\% = 92.308\%$$

### Menghadap Kanan Kamera

#### 1. SEMUA AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{9}{9 + 0} = \frac{9}{9} = 1$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{9}{9 + 3} = \frac{9}{12} = 0.75$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (0.75 \times 1)}{0.75 + 1} = \frac{1.5}{1.75} = 0.857$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{9 + 21}{9 + 0 + 3 + 21} \times 100\% = \frac{30}{33} \times 100\% = 90.909\%$$

## 2. SEMUA TIDAK AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{12}{12 + 1} = \frac{12}{13} = 0.923$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{12}{12 + 0} = \frac{12}{12} = 1$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (1 \times 0.923)}{1 + 0.923} = \frac{1.846}{1.923} = 0.947$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{12 + 25}{12 + 1 + 0 + 25} \times 100\% = \frac{37}{38} \times 100\% = 97.368\%$$

## 3. 1 AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{13}{13 + 3} = \frac{13}{16} = 0.813$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{13}{13 + 1} = \frac{13}{14} = 0.929$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (0.929 \times 0.813)}{0.929 + 0.813} = \frac{1.51}{1.742} = 0.867$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{13 + 22}{13 + 3 + 1 + 22} \times 100\% = \frac{35}{39} \times 100\% = 89.744\%$$

## Menghadap Kiri Kamera

### 1. SEMUA AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{12}{12 + 1} = \frac{12}{13} = 0.923$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{12}{12 + 0} = \frac{12}{12} = 1$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (1 \times 0.923)}{1 + 0.923} = \frac{1.846}{1.923} = 0.947$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{12 + 25}{12 + 1 + 0 + 25} \times 100\% = \frac{37}{38} \times 100\% = 97.368\%$$

### 4. 1 AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{13}{13 + 3} = \frac{13}{16} = 0.813$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{13}{13 + 1} = \frac{13}{14} = 0.929$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (0.929 \times 0.813)}{0.929 + 0.813} = \frac{1.51}{1.742} = 0.867$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{13 + 22}{13 + 3 + 1 + 22} \times 100\% = \frac{35}{39} \times 100\% = 89.744\%$$

## Menghadap Belakang

### 1. SEMUA AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{9}{9 + 0} = \frac{9}{9} = 1$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{9}{9 + 3} = \frac{9}{12} = 0.75$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (0.75 \times 1)}{0.75 + 1} = \frac{1.5}{1.75} = 0.857$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{9 + 25}{9 + 0 + 3 + 25} \times 100\% = \frac{34}{36} \times 100\% = 91.892\%$$

### 2. SEMUA TIDAK AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{12}{12 + 3} = \frac{12}{15} = 0.8$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{12}{12 + 0} = \frac{12}{12} = 1$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (1 \times 0.8)}{1 + 0.8} = \frac{1.6}{1.8} = 0.889$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{12 + 22}{12 + 3 + 0 + 22} \times 100\% = \frac{34}{36} \times 100\% = 94.444\%$$

### 3. 1 AMAN

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{13}{13 + 3} = \frac{13}{16} = 0.813$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{13}{13 + 3} = \frac{13}{16} = 0.813$$

$$F - \text{Score} = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}} = \frac{2 \times (0.813 \times 0.813)}{0.813 + 0.813} = \frac{1.322}{1.626} = 0.813$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \times 100\% = \frac{13 + 21}{13 + 3 + 3 + 21} \times 100\% = \frac{34}{40} \times 100\% = 85\%$$