YOLO Object Detection

1.Function Introduction

YOLO detection algorithm example uses images as input, performs algorithm inference using BPU, and publishes algorithm messages containing object categories and detection boxes. Currently, it supports four versions: YOLOv2、YOLOv3、Ultralytics YOLOv5、YOLOv5x、Ultralytics YOLOv8、YOLOv10、Ultralytics YOLO11、YOLO12、YOLO13.

Since all YOLOs after YOLOv8 are based on the Ultralytics algorithm framework, the Parser of YOLOv8 can be used. The relevant bin model can be found on GitHub ★ : Get it RDK Model Zoo.

The model is trained using the COCO dataset, and the supported object detection types include humans, animals, fruits, and vehicles, totaling 80 types.

Code repository: (https://github.com/D-Robotics/hobot_dnn)

Use cases: As a representative algorithm in single-stage object detection, the YOLO series has the advantages of fast speed and good generalization, and can be used for garbage recognition, vehicle detection, and other functions, mainly applied in autonomous driving, smart home, and other fields.

Vehicle detection case: (https://github.com/JunshengFu/vehicle-detection)

Fall detection case: (https://github.com/xiaobin1231/Fall-Detection-By-YOLOV3-and-LiteFlowNet)

2.Preparations

- RDK has been burned with the Ubuntu 20.04/22.04 system image provided by D-Robotics.
- RDK has successfully installed TogetheROS.Bot.
- RDK has installed MIPI or USB cameras. If there is no camera available, the algorithm can be experienced offline by local JPEG/PNG images or MP4, H.264, and H.265 videos.
- Confirm that the PC can access the RDK through the network.

3.User Guide

3.1Using a USB camera

YOLOv2 object detection algorithm example subscribes to images published by a USB camera, publishes algorithm msg after inference, and displays published images and corresponding results on PC browsers through the websocket package.

- Enable USB camera node

```
# Configure the tros.b environment
source /opt/tros/humble/setup.bash
```

```
# Configuring USB camera
export CAM_TYPE=usb

# Start the launch file
ros2 launch dnn_node_example dnn_node_example.launch.py
dnn_example_config_file:=config/yolov2workconfig.json
dnn_example_image_width:=480 dnn_example_image_height:=272
```

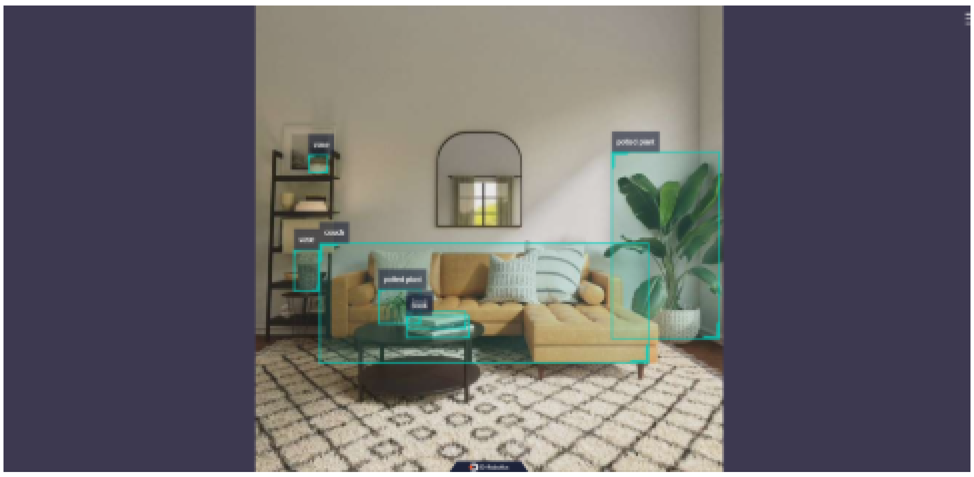
- Output Results

The terminal output during execution shows the following information:

```
[example-3] [WARN] [1655095347.608475236] [example]: Create ai msg publisher with
topic_name: hobot_dnn_detection
[example-3] [WARN] [1655095347.608640353] [example]: Create img
hbmem_subscription with topic_name: /hbmem_img
[example-3] [WARN] [1655095348.709411619] [img_sub]: Sub img fps 12.95
[example-3] [WARN] [1655095348.887570945] [example]: Smart fps 12.10
[example-3] [WARN] [1655095349.772225728] [img_sub]: Sub img fps 11.30
[example-3] [WARN] [1655095349.948913662] [example]: Smart fps 11.31
[example-3] [WARN] [1655095350.834951431] [img_sub]: Sub img fps 11.30
[example-3] [WARN] [1655095351.011915729] [example]: Smart fps 11.30
```

The log shows that the topic for publishing the inference results is `hobot_dnn_detection`, and the topic for subscribing to images is `/hbmem_img`.

You can view the image and algorithm rendering effects by entering http://IP:8000 in the browser on the PC (where IP is the IP address of the RDK):



3.2Use MIPI Cameras

YOLOv2 object detection algorithm example subscribes to images published by a MIPI camera and publish algorithm msg after inference. It displays published images and corresponding results on PC browsers through the websocket package.

- Enable MIPI camera node

```
# Configure the tros.b environment
source /opt/tros/humble/setup.bash
```

```
# Configuring MIPI camera
export CAM_TYPE=mipi

# Start the launch file
ros2 launch dnn_node_example dnn_node_example.launch.py
dnn_example_config_file:=config/yolov2workconfig.json
dnn_example_image_width:=480 dnn_example_image_height:=272
```

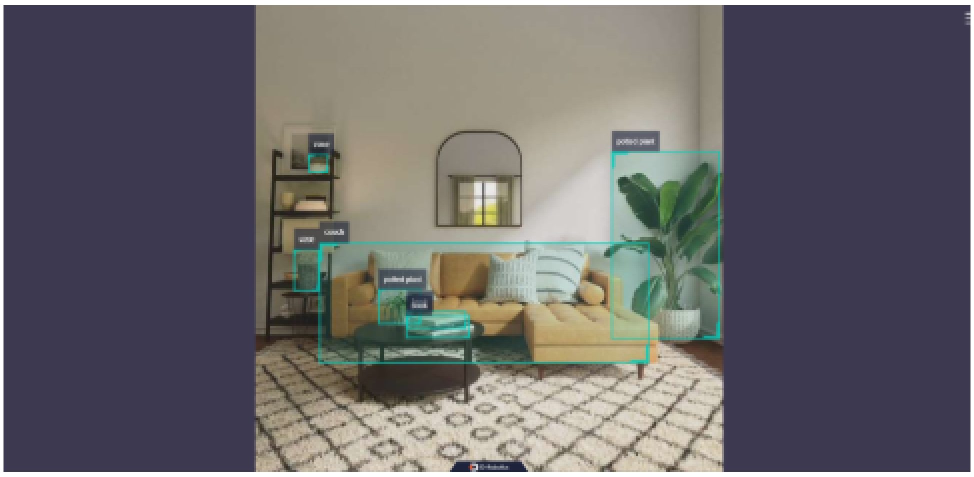
- Output Results

The terminal output during execution shows the following information:

```
[example-3] [WARN] [1655095347.608475236] [example]: Create ai msg publisher with
topic_name: hobot_dnn_detection
[example-3] [WARN] [1655095347.608640353] [example]: Create img
hbmem_subscription with topic_name: /hbmem_img
[example-3] [WARN] [1655095348.709411619] [img_sub]: Sub img fps 12.95
[example-3] [WARN] [1655095348.887570945] [example]: Smart fps 12.10
[example-3] [WARN] [1655095349.772225728] [img_sub]: Sub img fps 11.30
[example-3] [WARN] [1655095349.948913662] [example]: Smart fps 11.31
[example-3] [WARN] [1655095350.834951431] [img_sub]: Sub img fps 11.30
[example-3] [WARN] [1655095351.011915729] [example]: Smart fps 11.30
```

The log shows that the topic for publishing the inference results is `hobot_dnn_detection`, and the topic for subscribing to images is `/hbmem_img`.

You can view the image and algorithm rendering effects by entering http://IP:8000 in the browser on the PC (where IP is the IP address of the RDK):



3.1.3Local image reflow

YOLOv2 object detection algorithm uses local JPEG/PNG images offline. After inference, the rendered images of the results are stored in the local path.

- Running the recharge node

```
# Configure the tros.b environment
source /opt/tros/humble/setup.bash
```

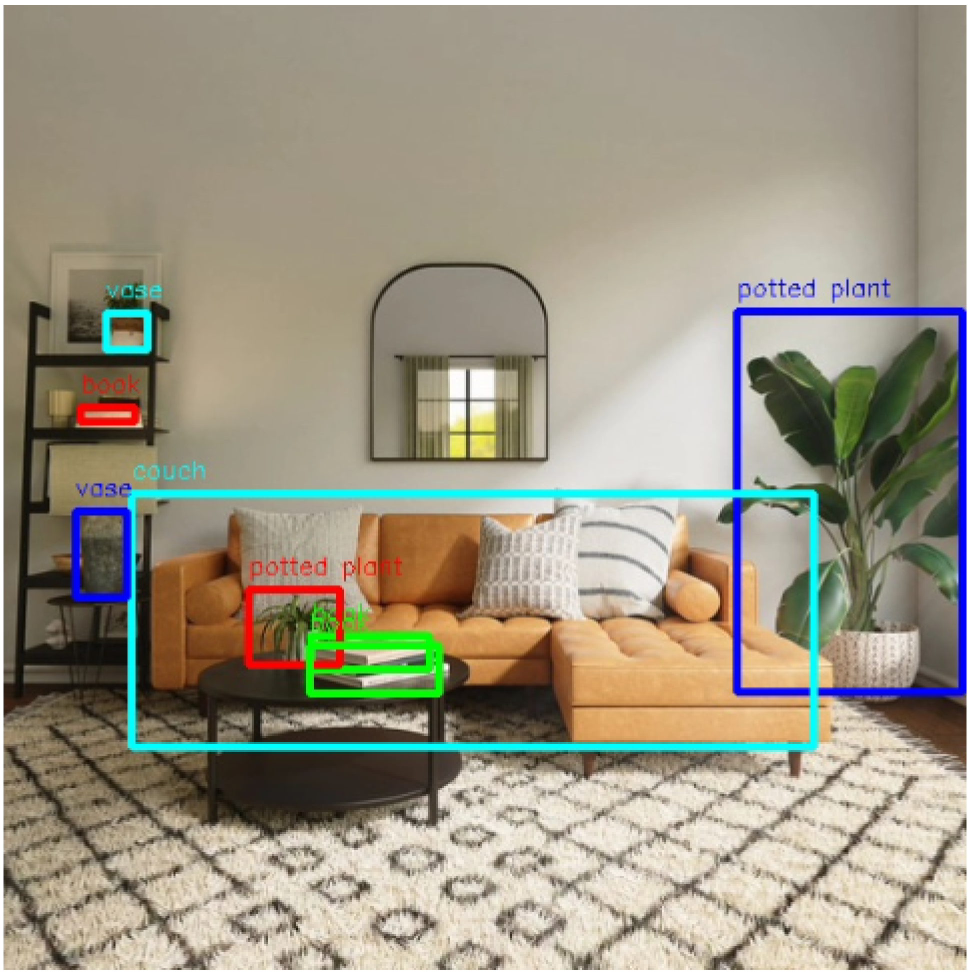
```
# Start the launch file
ros2 launch dnn_node_example dnn_node_example_feedback.launch.py
dnn_example_config_file:=config/yolov2workconfig.json
dnn_example_image:=config/target.jpg
```

- Recharge results

The terminal output during execution shows the following information:

```
[example-1] [INFO] [1654925067.952159234] [PostProcessBase]: out box size: 8
[example-1] [INFO] [1654925067.952227232] [PostProcessBase]: det rect: 464.03
196.145 605.525 434.865, det type: potted plant, score:0.813219
[example-1] [INFO] [1654925067.952319229] [PostProcessBase]: det rect: 86.5421
310.158 512.542 468.201, det type: couch, score:0.669208
[example-1] [INFO] [1654925067.952392268] [PostProcessBase]: det rect: 198.968
399.91 273.841 421.767, det type: book, score:0.539755
[example-1] [INFO] [1654925067.952465182] [PostProcessBase]: det rect: 159.861
370.656 217.685 417.746, det type: potted plant, score:0.480698
[example-1] [INFO] [1654925067.952533221] [PostProcessBase]: det rect: 51.2147
321.047 84.0969 375.842, det type: vase, score:0.433644
[example-1] [INFO] [1654925067.952607802] [PostProcessBase]: det rect: 70.0548
197.381 96.1826 221.062, det type: vase, score:0.399885
[example-1] [INFO] [1654925067.952675924] [PostProcessBase]: det rect: 197.706
405.271 278.929 435.743, det type: book, score:0.384268
[example-1] [INFO] [1654925067.952743463] [PostProcessBase]: det rect: 54.0955
256.68 88.6269 266.159, det type: book, score:0.307426
```

The log shows that the algorithm infers 8 targets from the input image and outputs the coordinates of the object detection boxes (the order of the coordinates is the top-left x and y coordinates and the bottom-right x and y coordinates of the bounding box) and the object categories. The rendered image file is saved as render_feedback_0_0.jpeg, and the rendering effect is shown below:



In addition to the YOLOv2, YOLOv3 and YOLOv5 are also supported. The algorithm can be switched using the config_file parameter in the startup command. For example, to use the YOLOv3, the startup configuration should be `dnn_example_config_file:="config/yolov3workconfig.json"`, and for the YOLOv5 algorithm, the startup configuration should be `dnn_example_config_file:="config/yolov5workconfig.json"`, and for the YOLOv8 algorithm, the startup configuration should be `dnn_example_config_file:="config/yolov8workconfig.json"`, and for the YOLOv10 algorithm, the startup configuration should be `dnn_example_config_file:="config/yolov10workconfig.json"`.