Real-Time Human Detection in Thermal Infrared Images

Samah A. F. Manssor (samah_ekora@yahoo.com)
Donghua University - Songjiang Campus: Donghua University

Shaoyuan Sun
Donghua University - Songjiang Campus: Donghua University

Mohammed Abdalmajed
Northwestern Polytechnical University

Shima Ali
National Information Center

Research Article

Keywords: Human detection, Thermal infrared (TIR) images, Surveillance, Person detector, Tiny-yolov3, Darknet-53.

Posted Date: April 19th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-188188/v1

Abstract

Human detection is a technology that detects pre-determined human shapes in the image and ignores everything else, which plays an irreplaceable role in video surveillance. However, modern person detectors have some inefficiencies in detecting pedestrians at night, and the accuracy rate is still insufficient. This paper presents a novel practical model for automatic real-time human detection at night-time. For this purpose, a new network architecture was proposed by improving the ting-yolov3 network for detecting pedestrians from TIR images based on the YOLO algorithm's tasks. The K-means clustering method clusters the image data, which contributes to obtaining excellent priority bounding-boxes. The proposed network was pre-trained on the original COCO dataset to obtain the initial weights. Through the comparison with the other three methods on the FLIR and DHU Night datasets showed that the proposed method performance was outperformed, in addition, to achieve a high score of accuracy (mAP%) in the TIR images. The method has a delay in detection time of 4.88ms. By improving the performance rates of human detection in TIR images, we expect this research to detect intruders in the night surveillance system.

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the manuscript can be downloaded and accessed as a PDF.

Figures

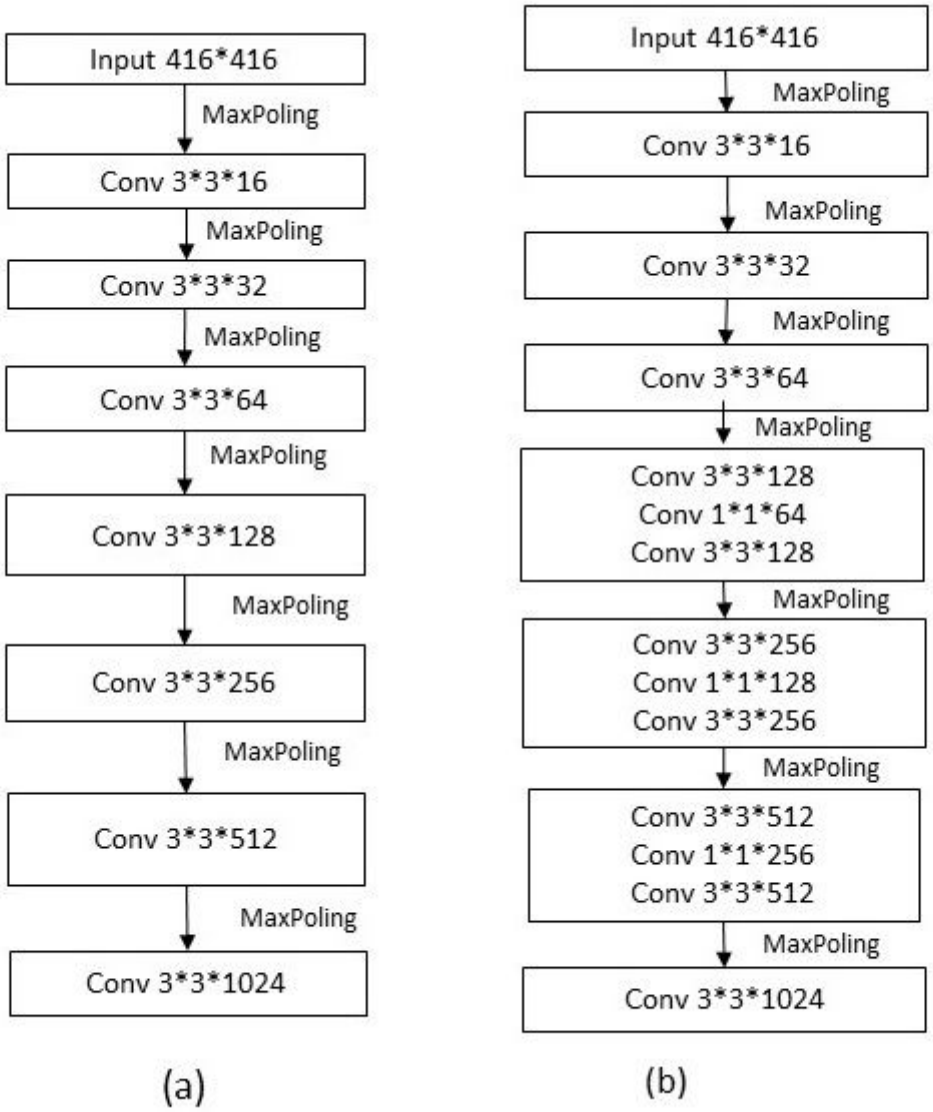


Figure 1

The network architecture for (a) simplified tiny-yolov3; and (b) improved tiny-yolov3

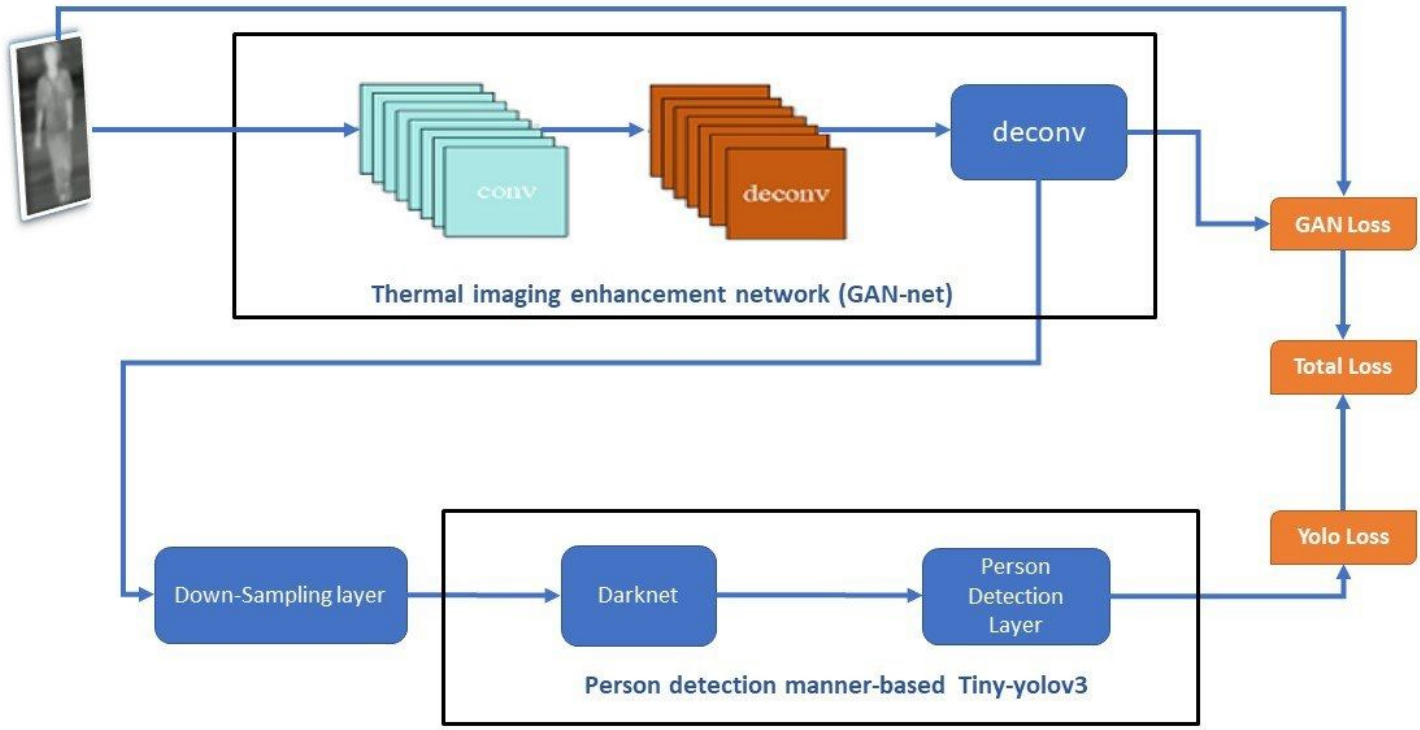


Figure 2

The proposed network block diagram

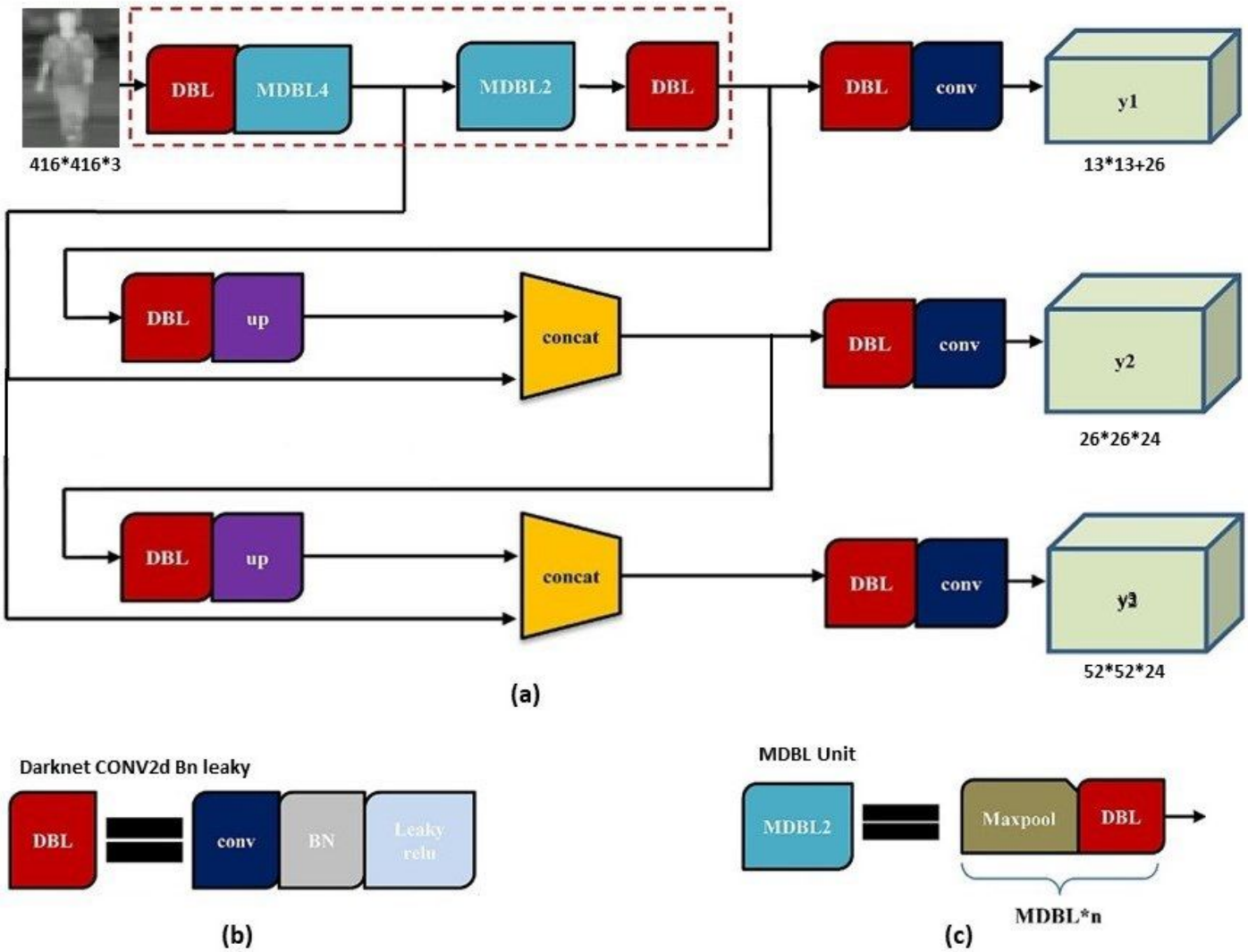


Figure 3

The design concept of (a) proposed PDM-Net (b), Darknet-53, and (c) MDBL Unit.

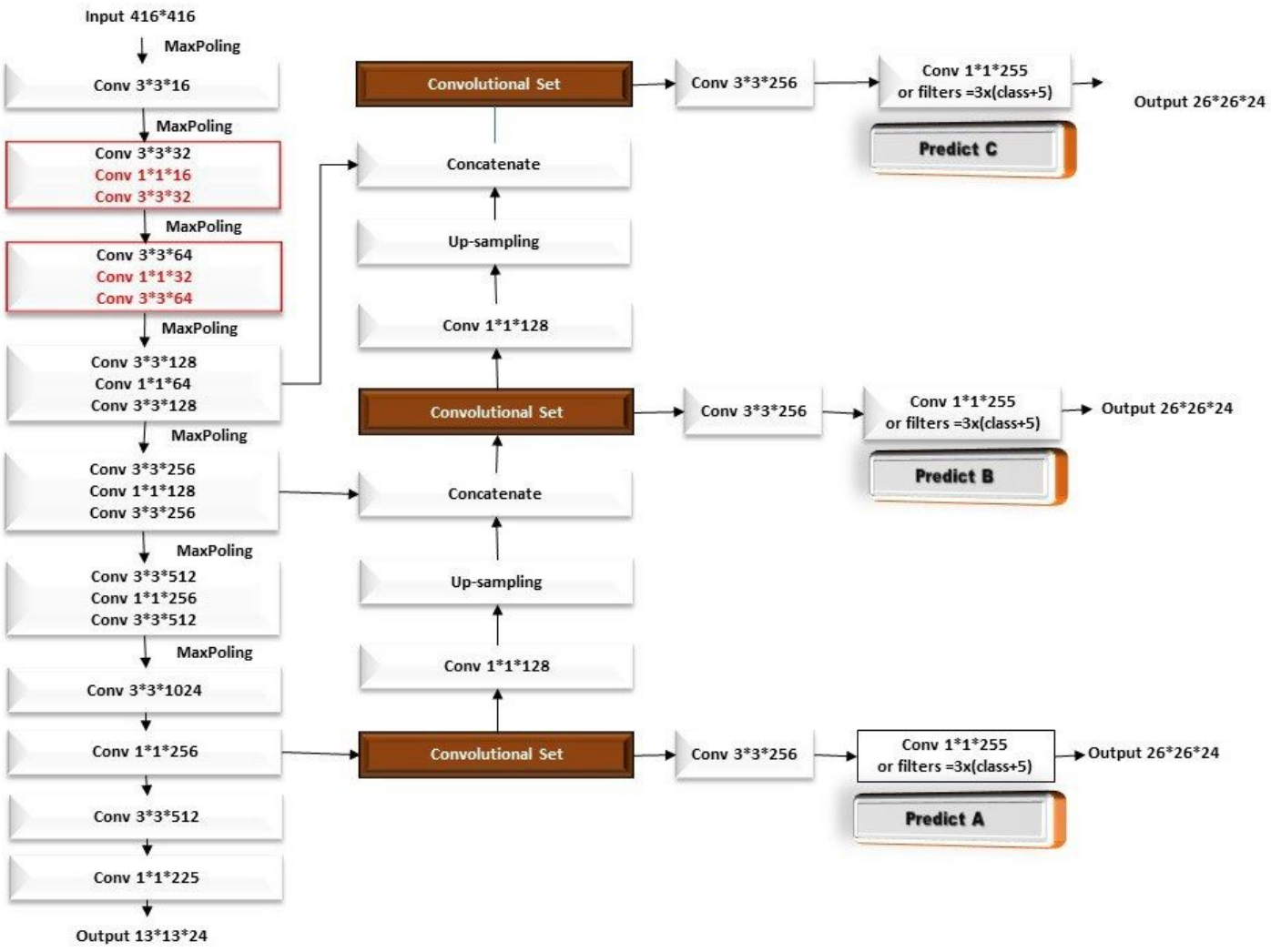


Figure 4

PDL-Net structure

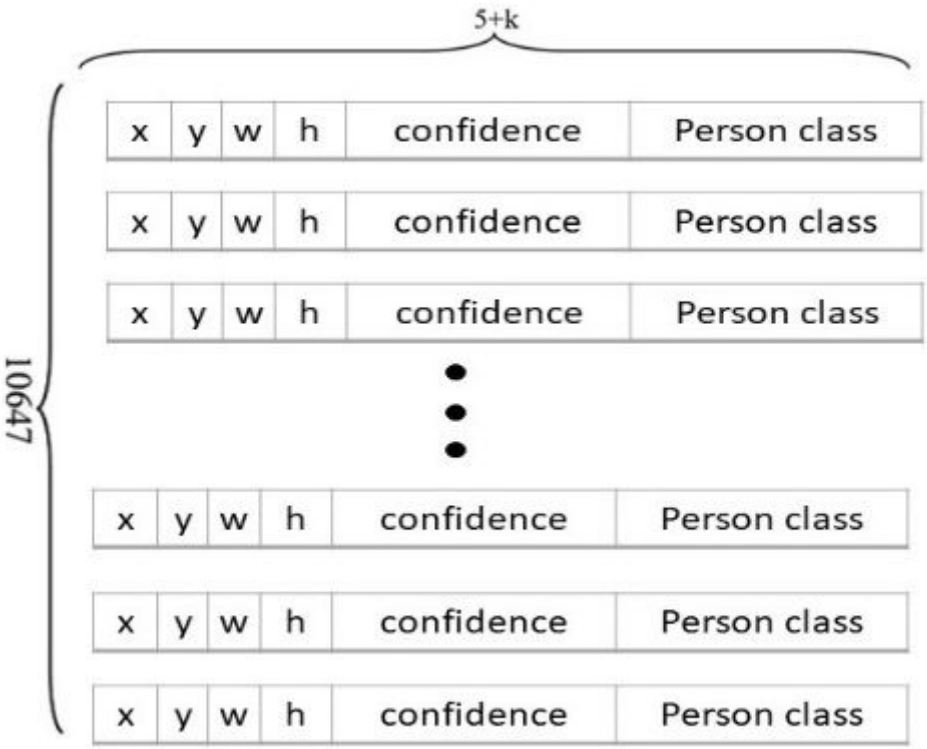


Figure 5

Network output format.

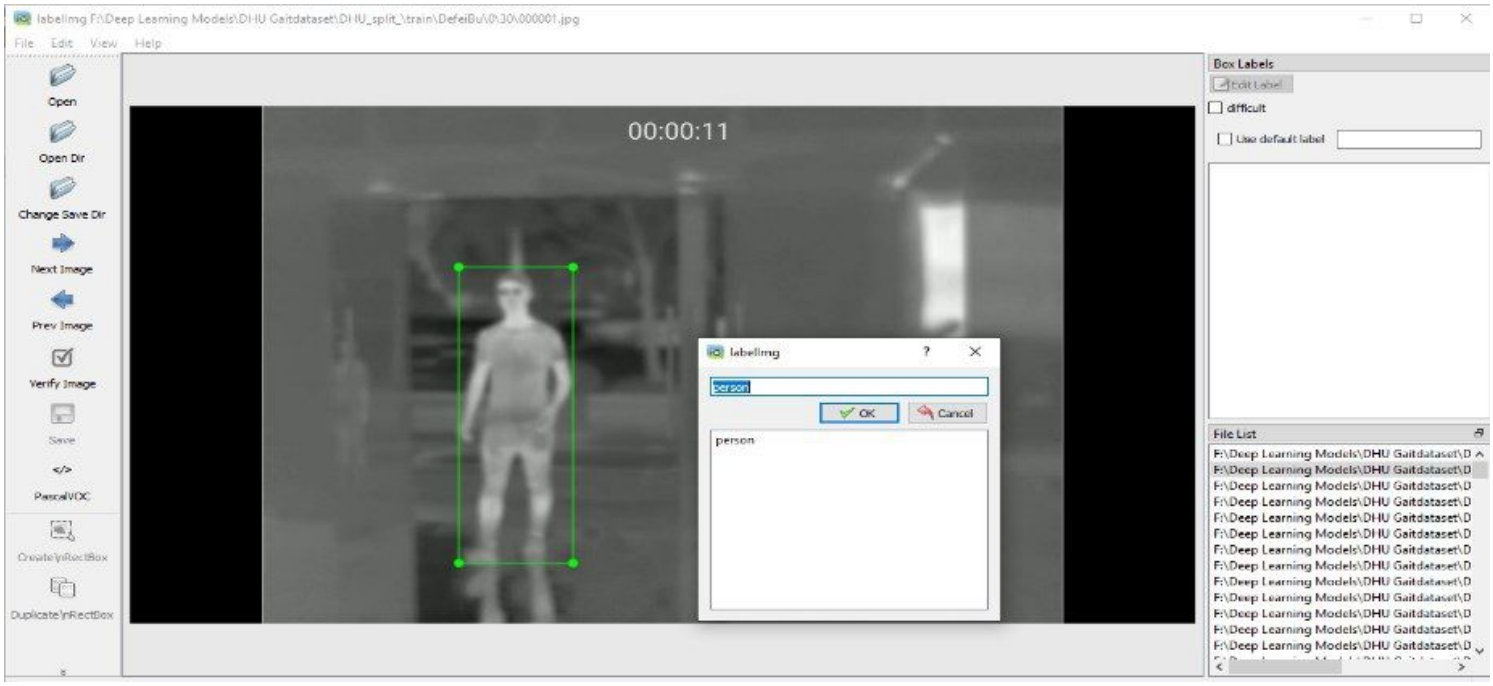


Figure 6

The annotation/labeling process of TIR images from the DHU Night dataset

(a)

```
0 0.380469 0.433333 0.096354 0.538889
```

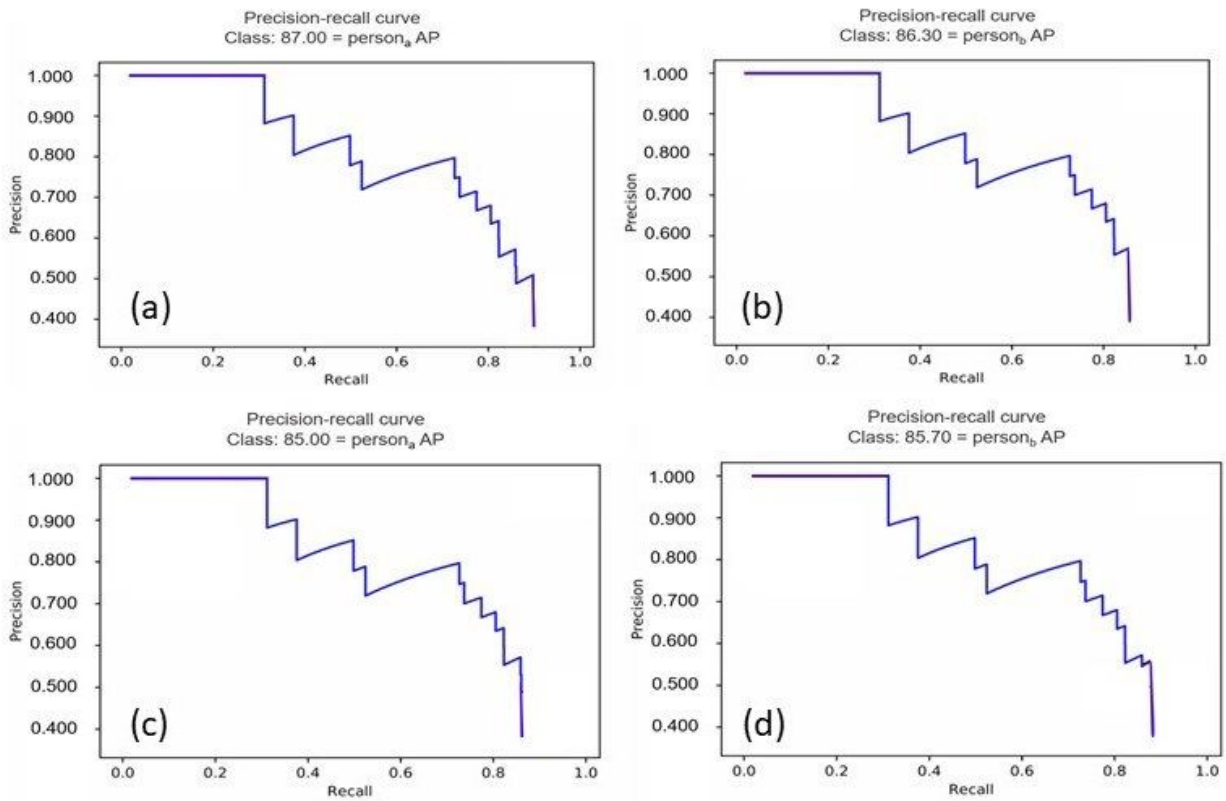
(b)

```
<annotation>
        <folder>000</folder>
        <filename>64.jpg</filename>
        <path>E:\DATABASES\Datasets\Dataset\DHU_Dataset\Gait_Rec\Defei\000\64.jpg</path>
        <source>
                <database>Unknown</database>
        </source>
        <size>
                <width>1920</width>
                <height>1080</height>
                <depth>3</depth>
        </size>
        <segmented>0</segmented>
        <object>
                <name>person</name>
                <pose>Unspecified</pose>
                <truncated>0</truncated>
                <difficult>0</difficult>
                <bndbox>
                        <xmin>613</xmin>
                        <ymin>180</ymin>
                        <xmax>813</xmax>
                        <ymax>741</ymax>
                </bndbox>
        </object>
</annotation>
```

Figure 7

The annotation file for the person presented in Fig. 6; (a) YOLO format, and (b) Pascal VOC format

(1)



(2)

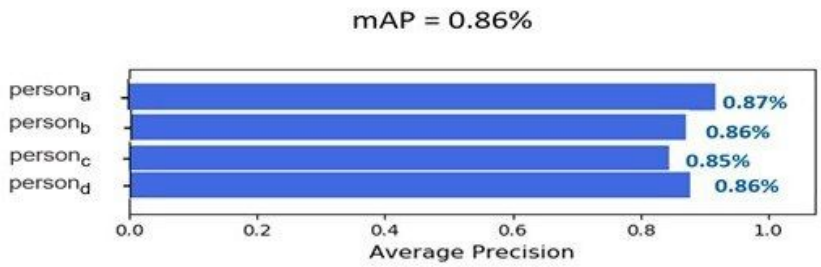


Figure 8

YOLOv3 evaluation test: (1) AP scores and PR curves for DHU Night trained YOLOv3 model, (2) Average precision per person (mAP %).

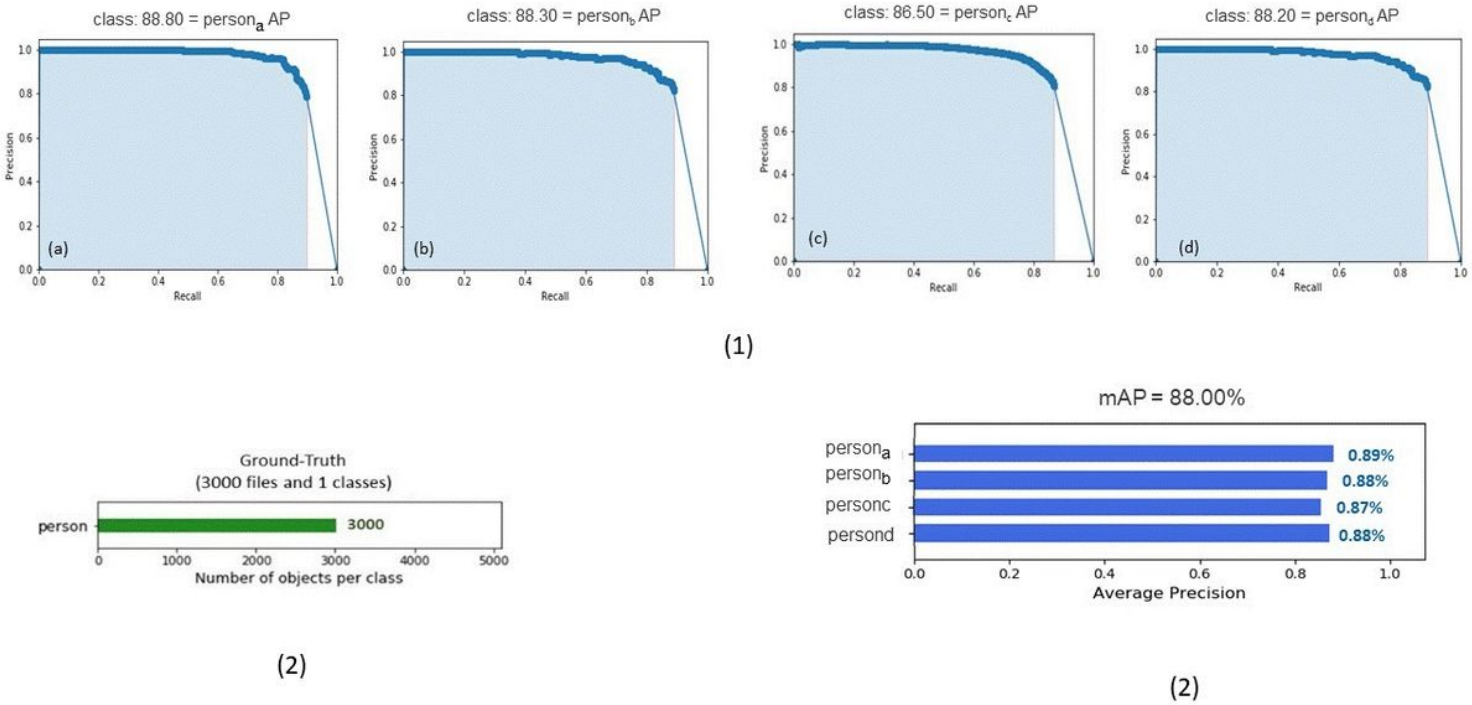


Figure 9

TF-YOLO evaluation test: (1) AP scores and PR curves for DHU Night trained TF-YOLO model; (b) Ground-Truth (c) Average precision per person (mAP %).

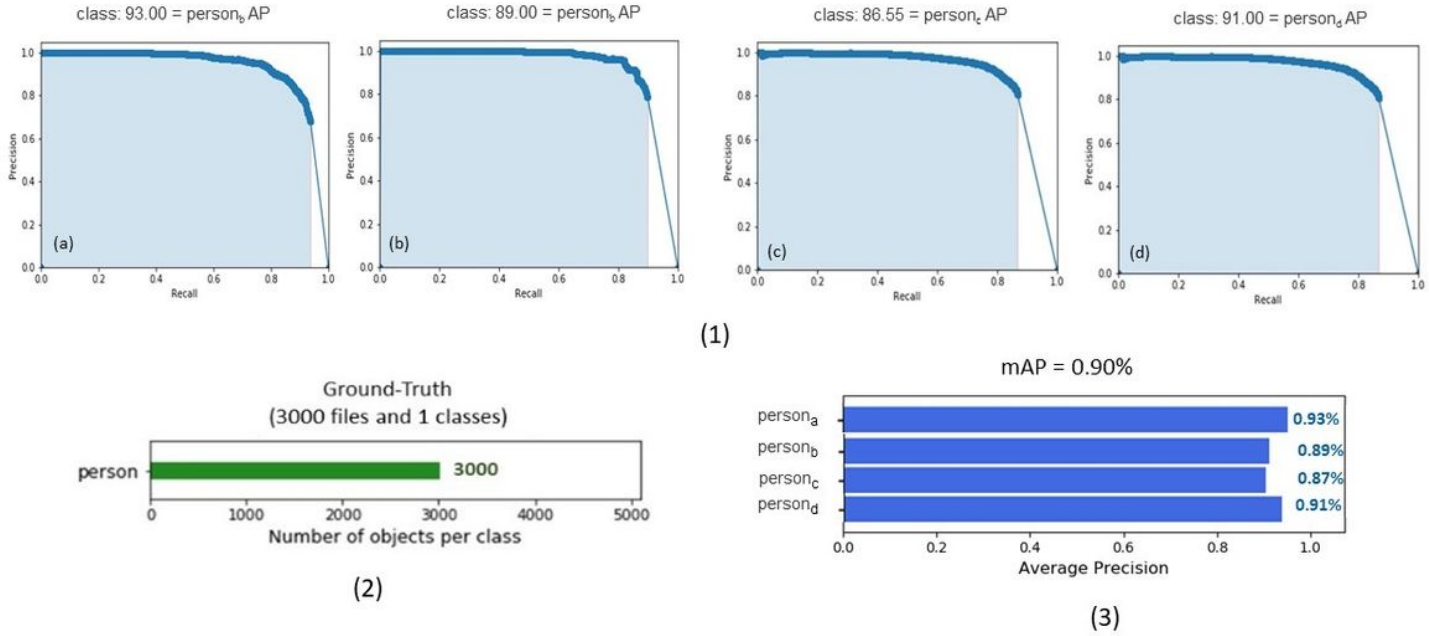


Figure 10

Evaluation test of the proposed method on the DHU Night Dataset: (1) AP score and PR curve for DHU Night trained our model; (2) Ground-Truth of objects per class; (3) Average precision per person (mAP %).

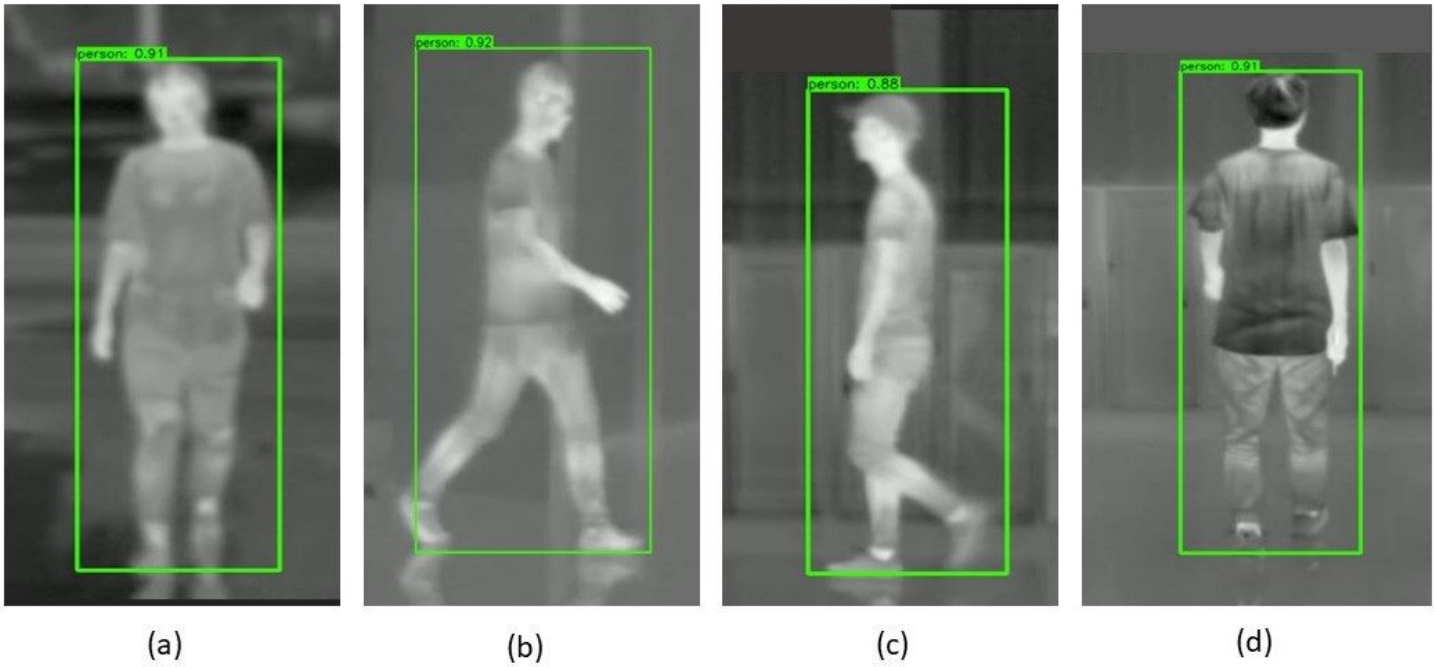


Figure 11

Person detection process at different regular walking conditions: (a) the person in front of the camera (0o); (b) the person on the right side from the camera (90o); (c) the person on the left side from the camera (180o); (d) the person is behind the camera (360o).

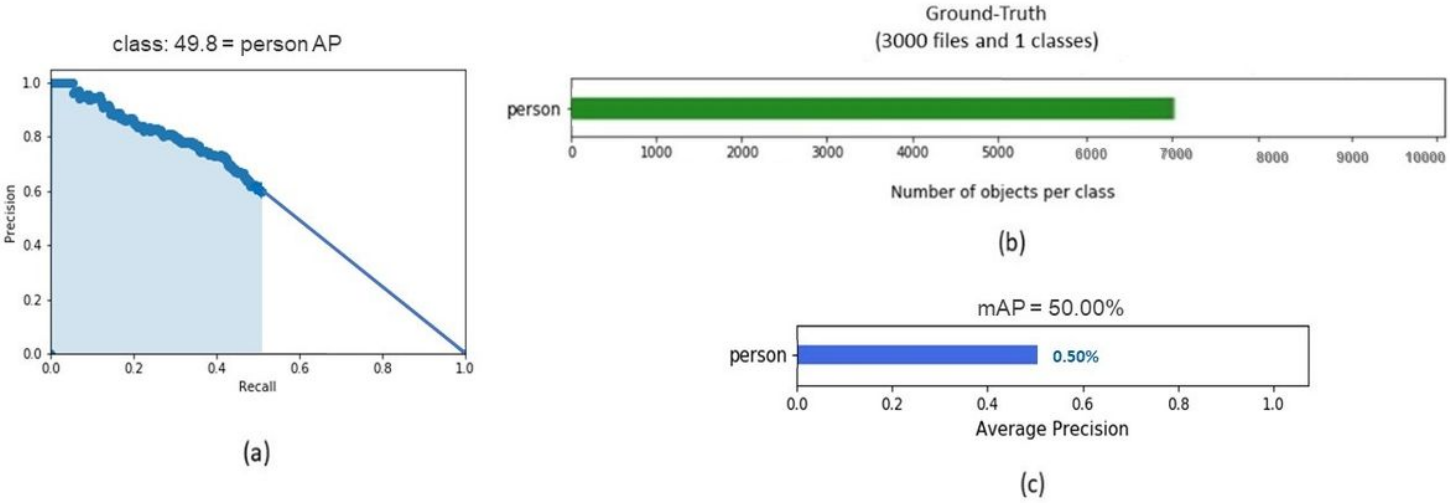


Figure 12

Evaluation test of the proposed method on the FLIR dataset: (a) AP score and PR curve for FLIR trained model; (b) Ground-Truth of objects per class; (c) Average precision per person (mAP %).

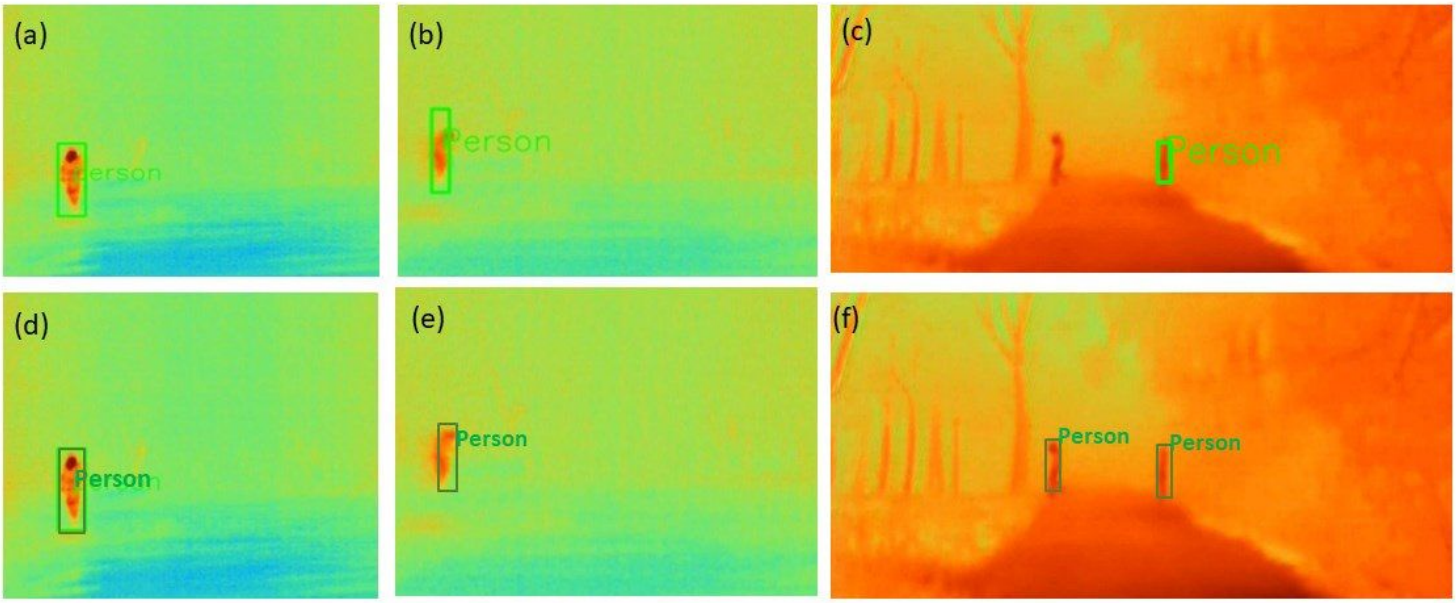


Figure 13

Results of human detection (small object) on TIR images recorded with the telephoto lens on different weather conditions, using YOLO model (a,b,c) opposite to proposed model (d,e.f)