MagnifierNet: Learning Efficient Small-scale Pedestrian Detector towards Multiple Dense Regions

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Problem Description

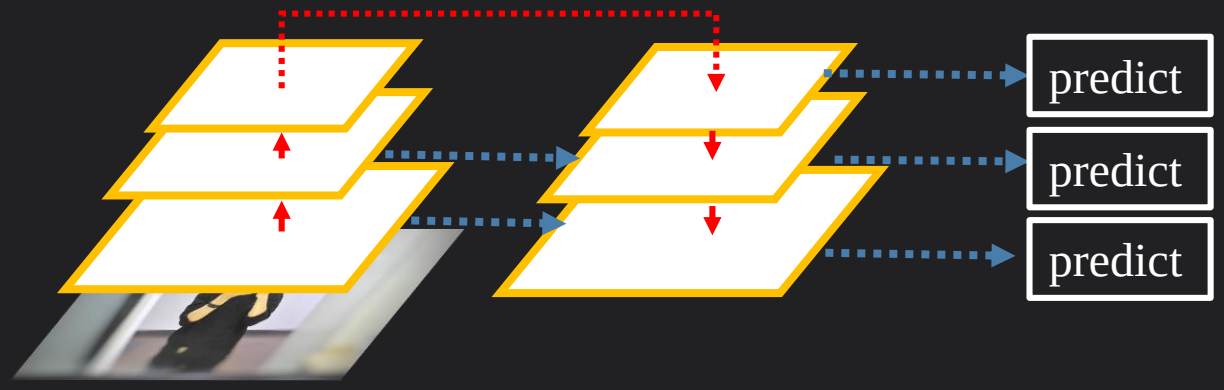
Detection results of small-scale pedestrians

Method	AP	AP_{50}	AP_{75}	AP_s	AP_m	AP_l
YOLOv3	33.0	7.9	34.4	18.3	25.4	41.9
RetinaNet	40.8	61.1	44.1	24.1	44.2	51.2
CornerNet	42.1	57.8	45.3	20.8	44.8	56.7
FCOS	44.7	64.1	48.4	27.6	47.5	5.6
CenterNet	45.1	63.9	49.3	26.6	47.1	57.7
TridentNet	48.4	69.7	53.5	31.8	51.3	60.3
SNIP	48.3	69.7	53.7	31.4	51.6	60.7

Problem Description

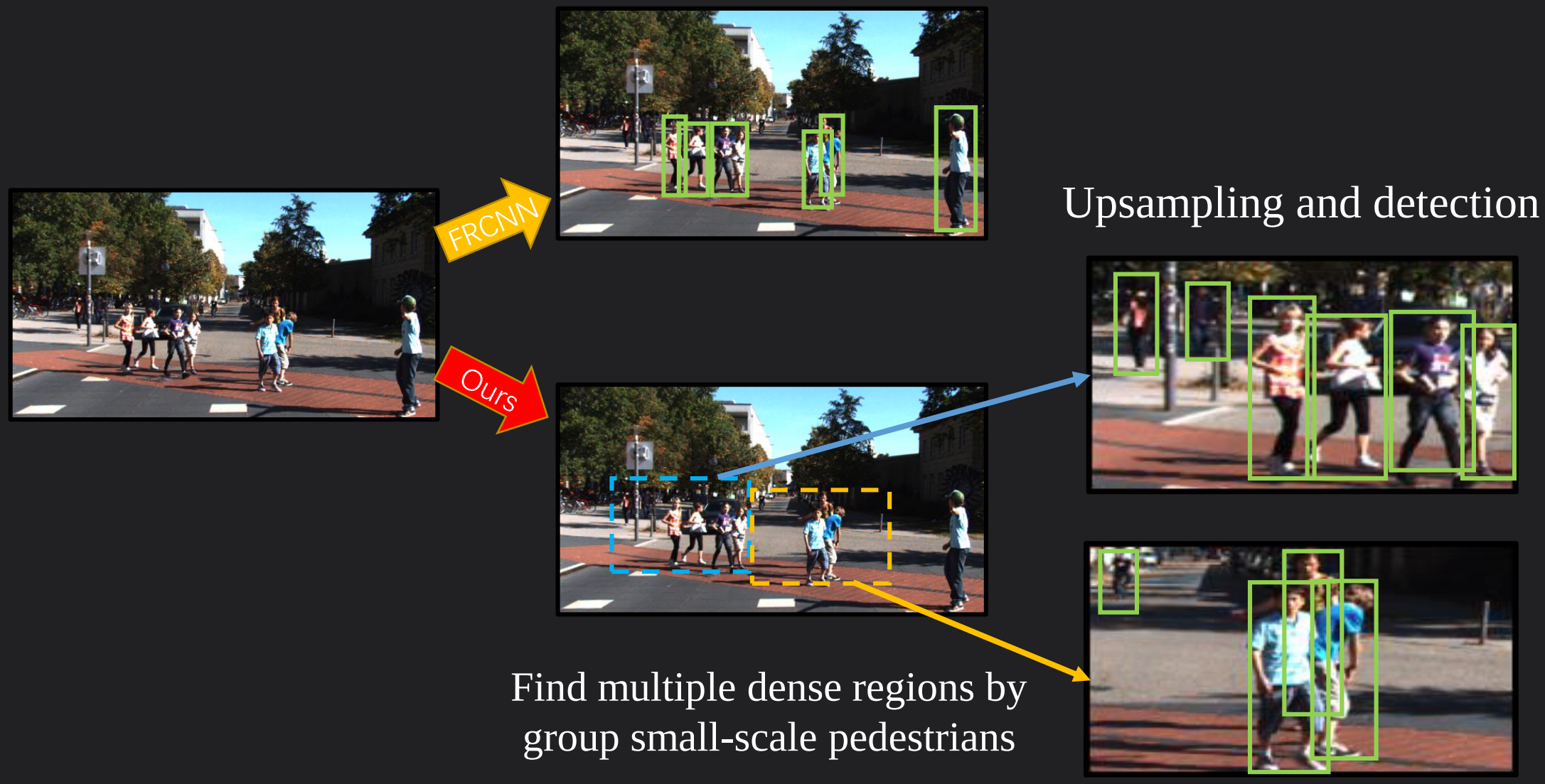
Conventional Solution

Image Pyramid

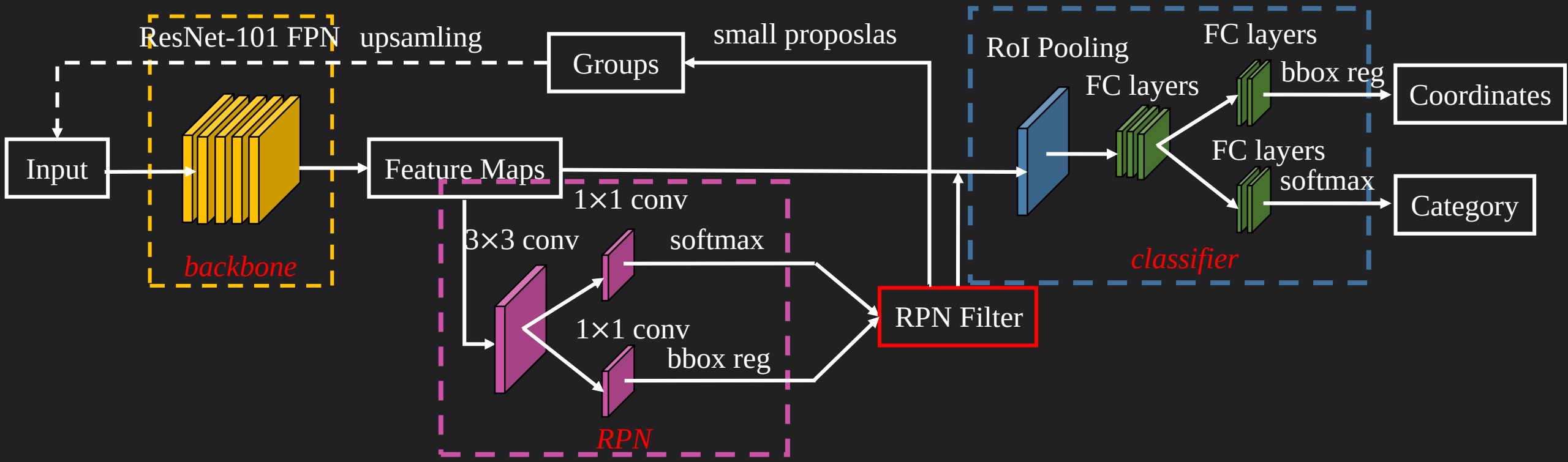


Feature Pyramid

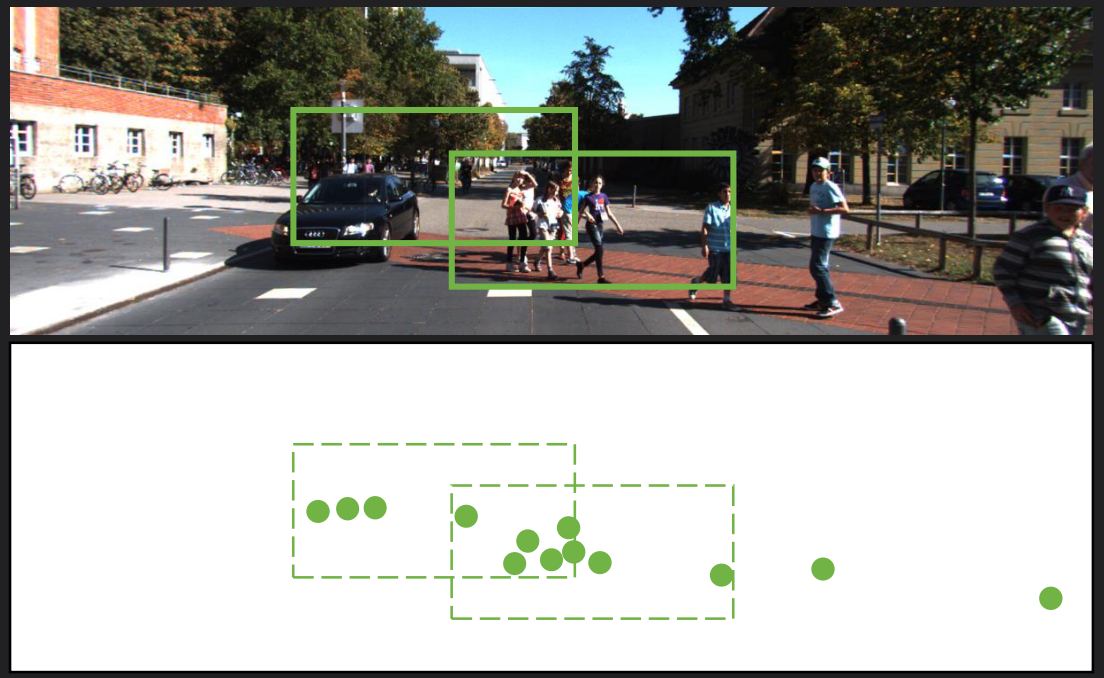
MagnifierNet

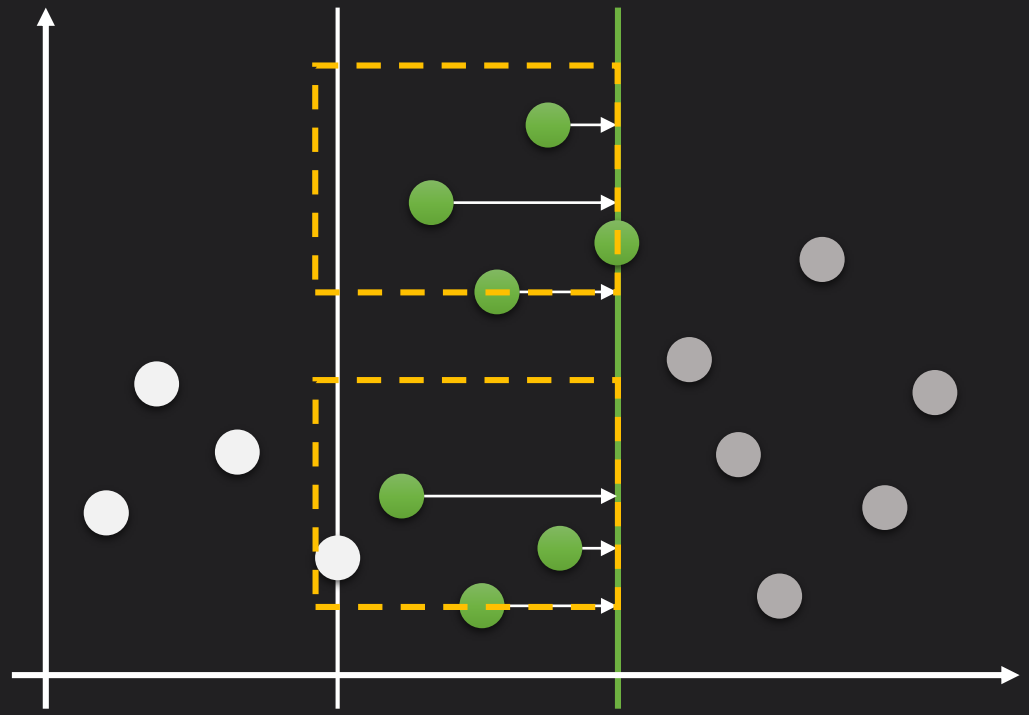


MagnifierNet



Grouping algorithm





$$dp(x_i) = \min_{x_i - x_j < gw} \{dp(x_j) + count(x_j, x_i)\}$$

Area threshold

The value of upsampling scale factor s_t is computed as follow:

$$s_t = \frac{\overline{L_t}}{\overline{S_t}} \tag{1}$$

Then, our calculation method for the size of the group box is defined as:

$$gw_t \cdot gh_t \cdot s_t = w \cdot h \tag{2}$$

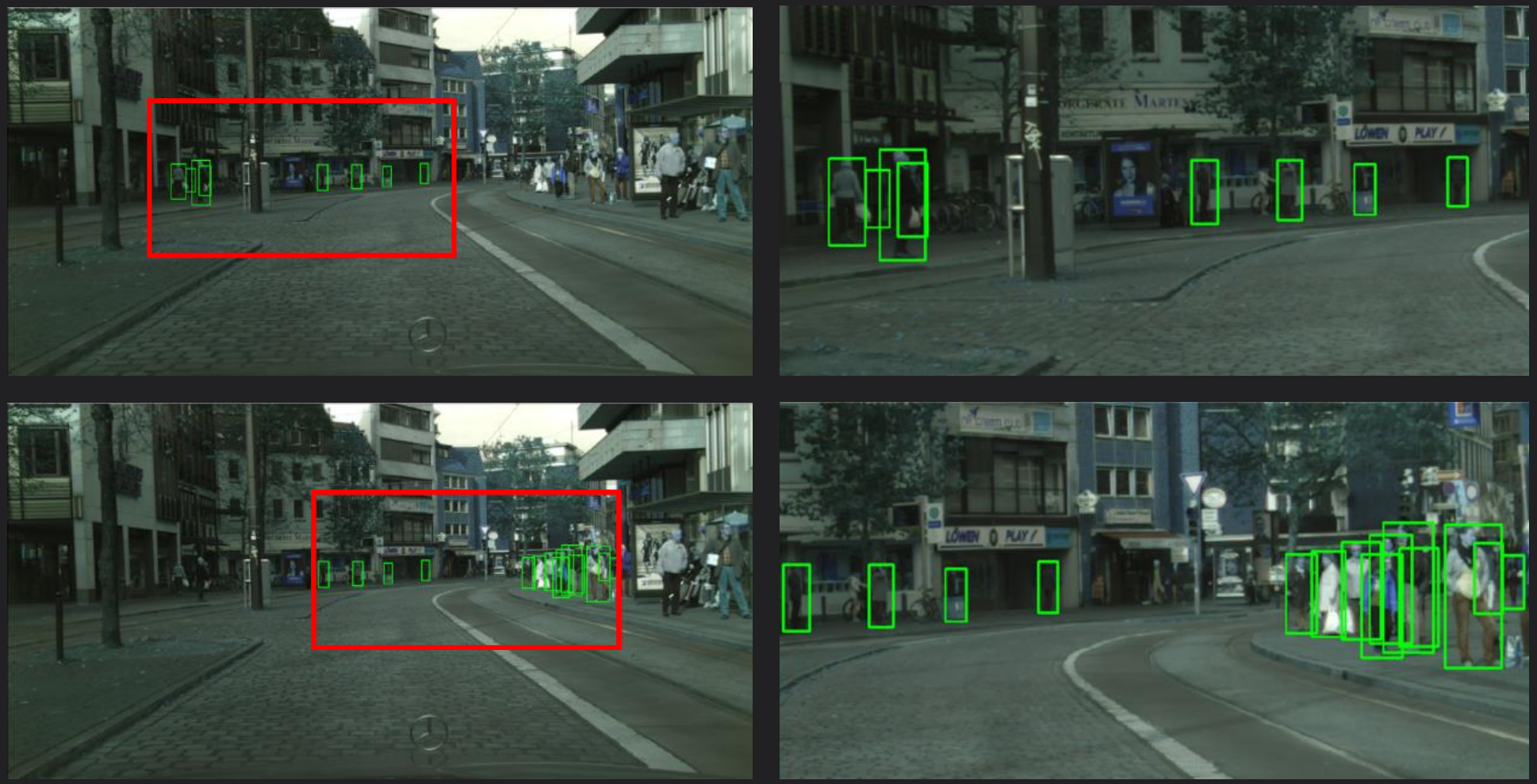
The size of the group box can be determined by:

$$\begin{aligned} gw_t &= \frac{w}{\sqrt{s_t}} \\ gh_t &= \frac{h}{\sqrt{s_t}} \end{aligned} \tag{3}$$

Select t that minimizers the value of $KL\big(P_t(\xi)||Q_t(\xi)\big)$:

$$\hat{t} = \arg\min_t KL\big(P_t(\xi)||Q_t(\xi)\big) \tag{4}$$

Data augmentation



Analysis

(a) Ground truth

(b) Faster R-CNN

(c) MagnifierNet

(d) MagnifierNet with data augmentation

Comparison to state-of-the-art

Comparisons with state-of-the-art methods on CityPersons

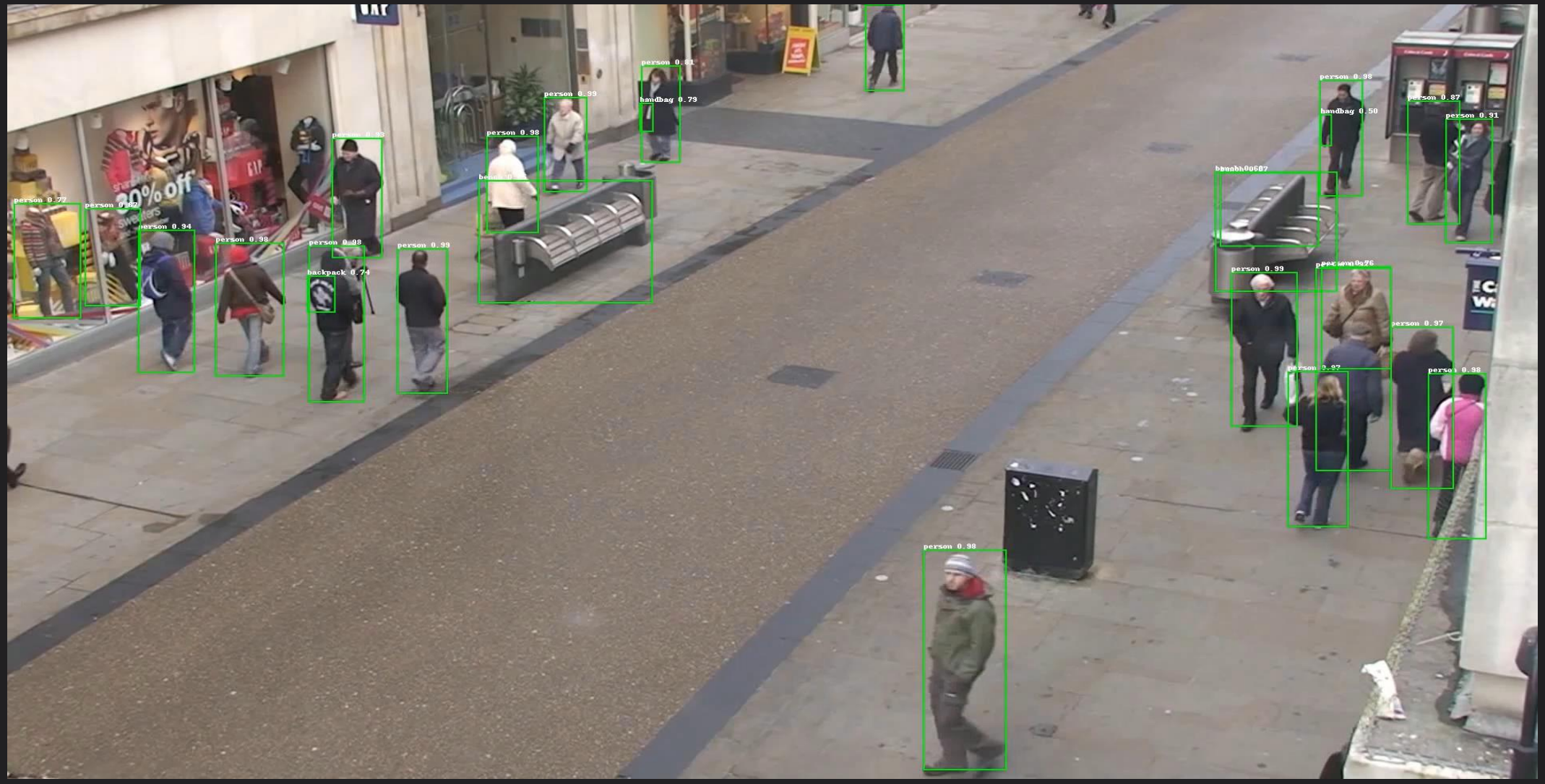
Method	Reasonable	Heavy	Partial	Bare	Small	Middle	Large
FRCNN	15.4	-	-	-	25.6	7.2	7.9
FRCNN+Seg	14.8	-	-	-	22.6	6.7	8.0
OR-CNN	12.8	55.7	15.3	6.7	-	-	-
RepLoss	13.2	56.9	16.8	7.6	-	-	-
TLL+MRF	14.4	52.0	15.9	9.2	-	-	-
ALFNet	12.0	51.9	11.4	8.4	19.0	5.7	6.6
CSP	11.0	49.3	10.4	7.3	16.0	3.7	6.5
Baseline	18.7	52.5	19.1	13.1	32.6	12.1	8.4
+ DA	15.3	48.5	12.6	12.0	18.2	7.2	9.3
+ GA	15.6	49.7	15.5	11.0	22.9	9.4	8.0
+ DA & GA	10.8	42.2	10.1	7.4	12.6	5.5	7.7

Comparison to state-of-the-art

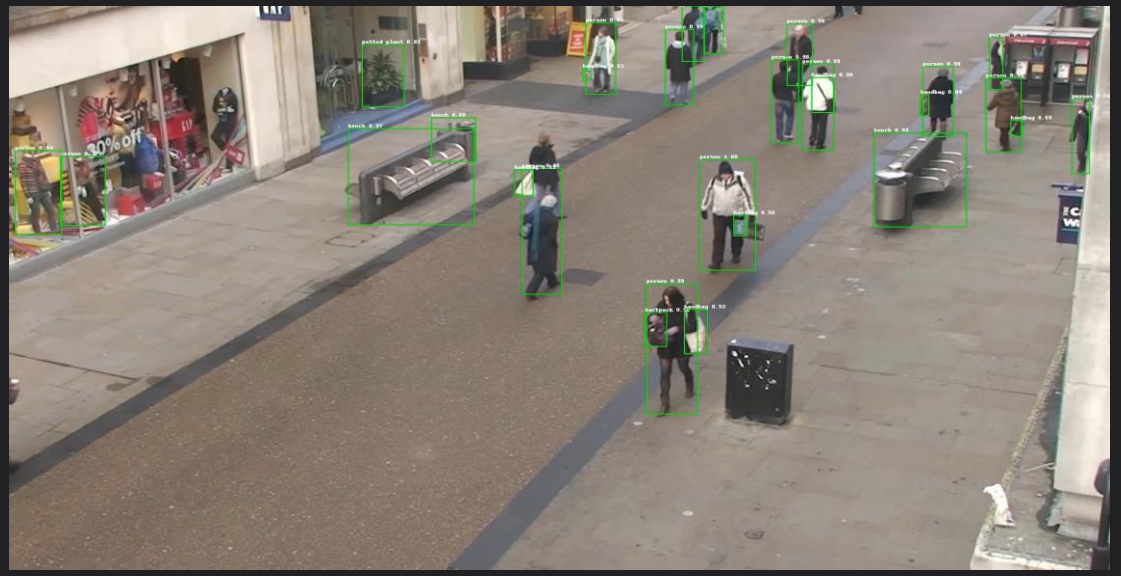
Comparisons with state-of-the-art methods on KITTI test set

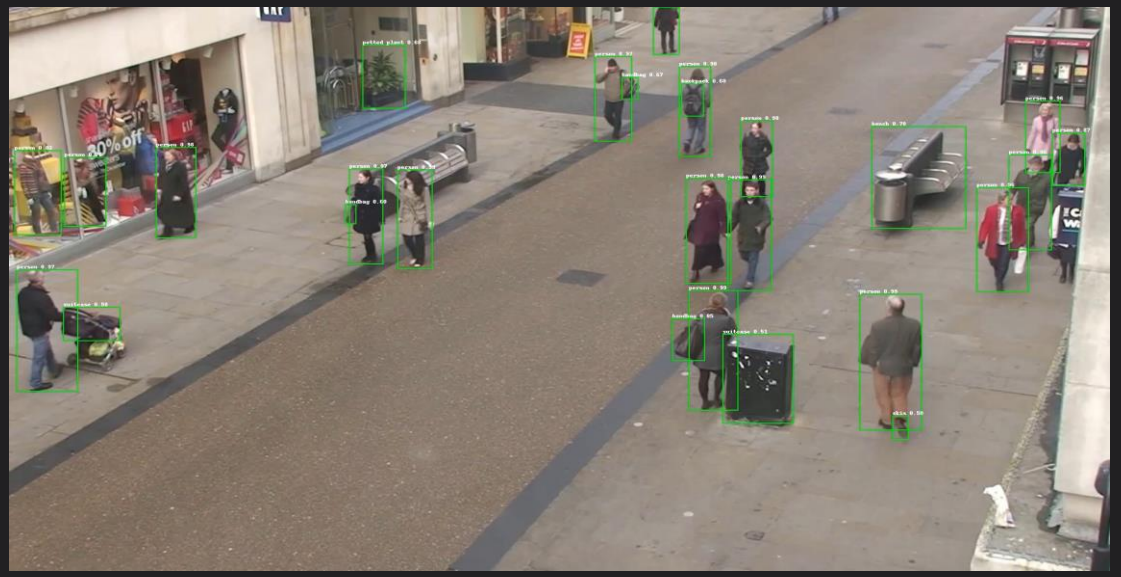
Method	Easy	Moderate	Hard
FRCNN	78.35	65.91	61.19
MS-CNN	83.70	73.62	68.28
RPN+BF	75.58	61.29	56.08
F-ConvNet	83.63	72.91	67.18
VMVS	81.11	70.89	67.23
MonoPSR	85.60	68.56	63.34
SubCNN	83.17	71.34	66.36
Aston-EAS	85.12	74.52	69.35
MHN	85.80	74.6	68.94
CLA	-	73.96	-
Baseline	84.15	68.78	63.6
+ DA	85.51	73.75	68.54
+ GA	86.21	72.67	67.55
+ DA & GA	86.95	74.95	69.50

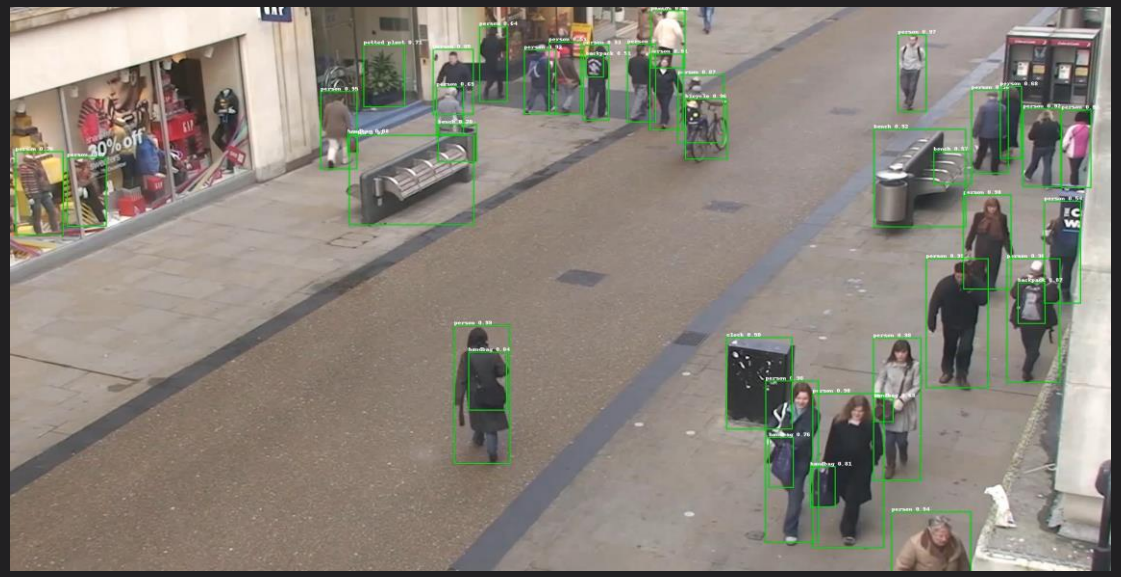
Visualization



Visualization







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