You Only Look at Interested Cells – An Efficient Way for Detecting On-road Risks

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Background

On-road risk detection is one of the prevailing applications in object detection and recognition, and it is also a crucial part of the driving assistance system. Only a tiny amount of research has recently been conducted to create a lightweight road risk detection system for low-cost vehicles such as mobility scooters. However, road risk detection tasks require strict requirements for real-time and high detection accuracy. Furthermore, most of the detection methods in use today need expensive computational power. Therefore, this is necessary to find a more efficient and effective way to solve the above problems.

Our proposal

Our proposed approach is called You Only Look at Interested Cell (YOLIC). The detection model leverages both bounding box and semantic segmentation methods. In this way, a detected object can be represented by one or more small cells (or blocks) instead of one big bounding box or pixel area where each cell will focus on the different parts of the object. Fig. 1 illustrates interested cells for on-road risk detection. The main idea is to focus on road and traffic signal cells. The cell sizes can be different depending on the distances and other factors.

On-road risk detection

In our on-road risk detection system, a depth camera is used and mounted on a mobility scooter. Based on the scooter speed and the human response time, we regard the road within 6 meters from the mobility scooter as the detection area. As shown in Fig. 1, the first three rows (i.e., cells 1 to 32) are the notification area. The danger area is the last four rows (i.e., cells 33 to 96). The white tapes on the floor are the reference lines. We set 96 cells to detect on-road risks and eight to detect traffic signs.

Experimental Results

In our experiment, we have defined 11 types of objects. The following results can be obtained if we use MobileNet v2 as the backbone network for detection. To know the detection performance more directly. Please scan the QR code to see an actual test demo.

categories	MobileNet v2		
	Precision	Recall	F1-score
Bump	0.9267	0.9487	0.9376
Column	0.8750	0.8645	0.869
Dent	0.8817	0.8887	0.8852
Fence	0.9227	0.9465	0.9345
Creature	0.8772	0.9199	0.8980
Vehicle	0.8960	0.9496	0.9220
Wall	0.9440	0.9567	0.9503
Weed	0.9342	0.9615	0.9476
Zebra Crossing	0.9695	0.9819	0.9756
Traffic Cone	0.8762	0.8752	0.8757
Traffic Sign	0.8415	0.7464	0.7911
Normal	0.9922	0.9875	0.9898
All Risks	0.9420	0.9633	0.9526

Figures to illustrate the proposed method

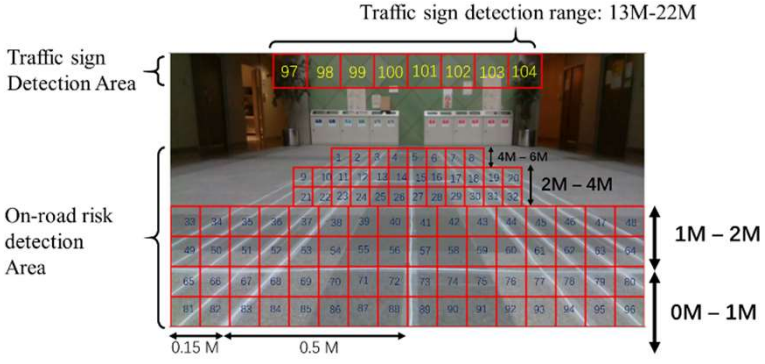

Fig. 1: Interested cells for on-road risk detection

Road risk detection demo