Smartbike: Cyclists' Perception of Risk

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Overview

Bicycle

Capture Data
- Video
- Acceleration and velocity signals
- GPS

Scene Perception (Where are the objects in relation to the cyclist)

Dynamic Perception (How moving objects distress the cyclist)

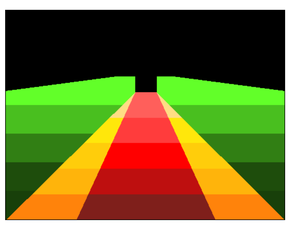
Perception of Risk Assessment

Scene Perception

1 – Estimating the Focus of Expansion

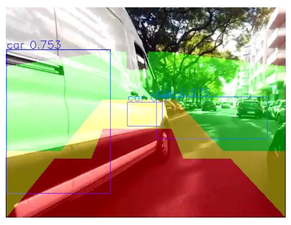

▷ **Optical flow** and **object detection**
▷ Estimation of the **Focus of Expansion** (FOE)

2 – Computing the Risk Descriptor



▷ Divide the image into **25 regions** based on the FOE that map:
  └→ **Path Occupation**
  └→ **Proximity** to the cyclist
▷ Compute a risk descriptor in each region based on the location and type of objects in that region.

3 – Risk Perception



Proximity Risk Level: 3

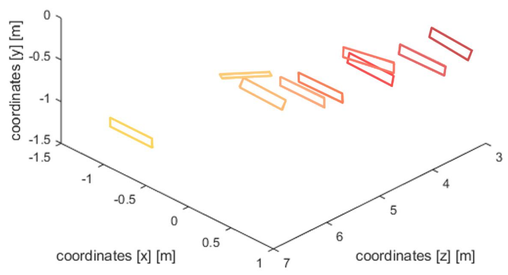
▷ **Compare risk descriptor** to **manually classified images**
▷ **Assess risk** based on **two metrics**: Path Occupation and Proximity.
▷ Classify risk into **3 levels of risk**

Dynamic Perception

1 – Detect and Track Vehicles


▷ **License plate recognition**
▷ Letters sequence and plate coordinates
  └→ **vehicle tracking**.

2 – Vehicles' Speed Estimation



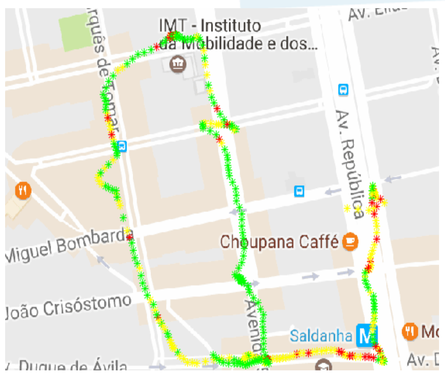
▷ **Computation of homography matrices** between license plates
▷ **Translation vectors** are estimated to then estimate **vehicle speed**.

3 – Overtaking Maneuver Identification

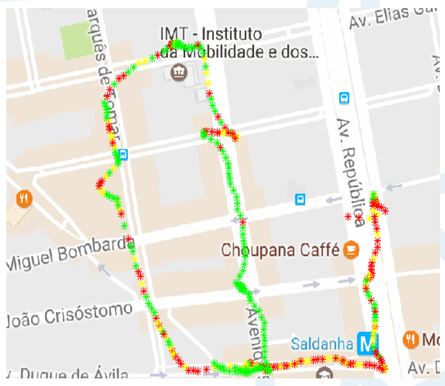
Two important events are recognized:
1) vehicle overtaking bicycle and
2) bicycle overtaking vehicle.

Results

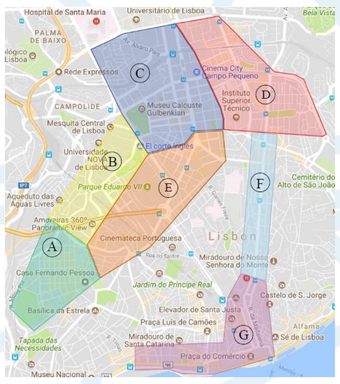
▷ Compute geo-referenced risk
▷ Green is low level risk, yellow medium and red high risk level.



Distance Risk Descriptor



Path Occupation Risk Descriptor



▷ Map division in 7 zones
▷ Areas A, C, E and G (**residential** and **commercial** areas):
  └→Average **speed is low**
▷ Areas B, D and F (**more request**):
  └→**Higher speed overtaking**
  └→**Large traffic flow**

Speed(sp) [km/h] \ Area	A	B	C	D	E	F	G	Total
sp ≤ 20	59.09%	12.20%	50%	22.41 %	27.78%	24.36 %	66.67%	84
20 < sp ≤ 30	18.18%	21.95%	18.75%	15.52%	47.22%	15.38%	19.05%	61
30 < sp ≤ 40	13.64%	43.90%	18.75%	25.86%	19.44 %	24.36%	9.52%	69
sp > 40	9.09%	21.95%	12.50%	36.21%	5.56%	35.90%	4.76%	66
Total	22	41	32	58	36	78	21	288

Table 1: Overtaking maneuvers detections results for each area.