
Early Detection of Cars Exiting Road-side Parking

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Risky road-side parking

- Leaving a road-side parking is risky due to the reduced visibility during the insertion in the traffic flow
- In particular, for angle or perpendicular space backing out of a parking space is a high-risk maneuver because the driver view can be blocked
- A vehicle driver traveling along road-side parking spaces knows how to anticipate this risk
- Autonomous vehicles usually anticipates this risk by reducing speed

Goal of early detection

- To face the risk of a vehicle exiting suddenly from a parking space, the reaction time of the autonomous vehicle should be short
- This may also induce a strong uncomfortable deceleration
- Being able to sufficiently anticipate these exits can improve the safety and smoothness of the route of Communicant and Autonomous (CAV) Vehicles
- We have thus designed an original warning system for detecting drivers getting into their vehicle using a camera in order to anticipate exits from parking spaces by more than 10 seconds

The warning system

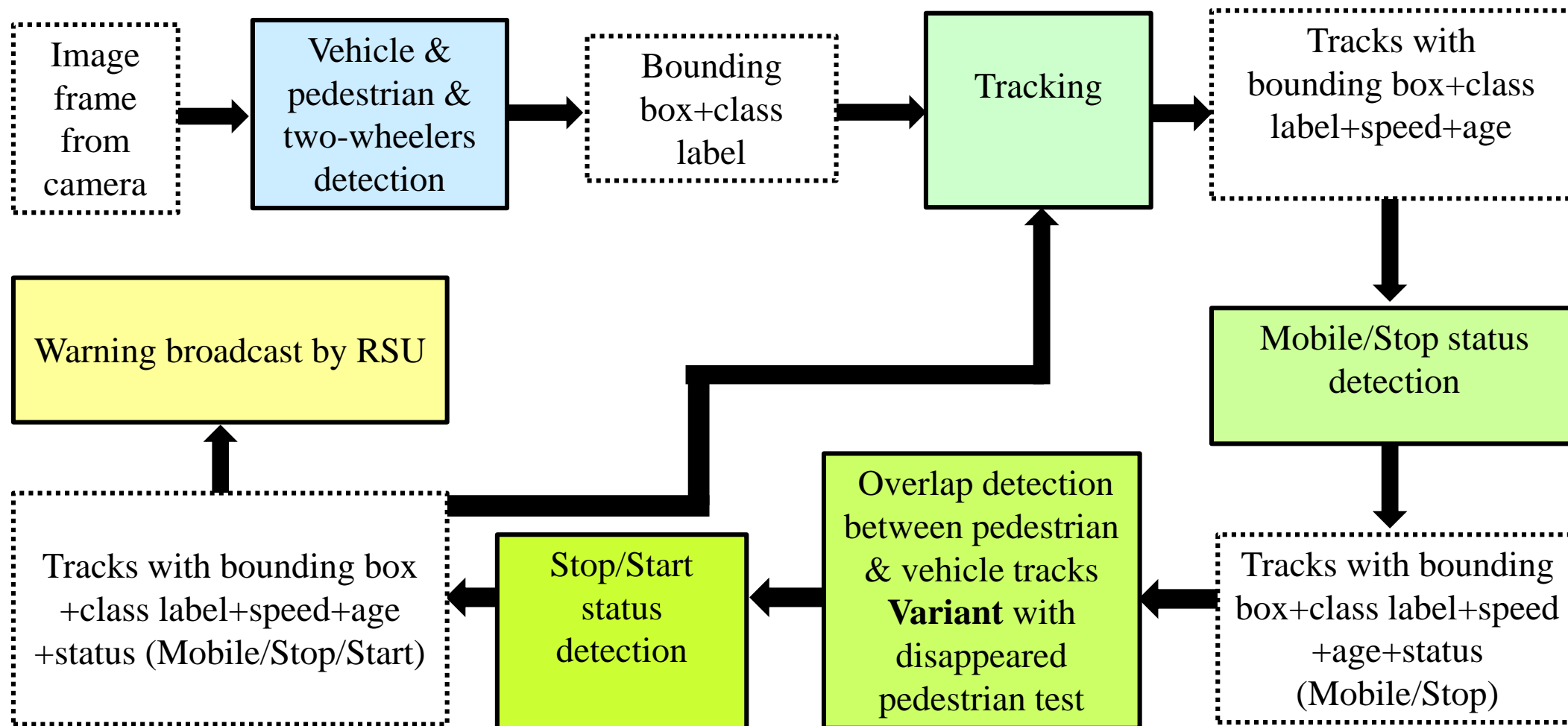


- A camera fixed at a height above 5 meters
- A Road Side Unit (RSU) for communication to the Communicant and Autonomous Vehicle (CAV)
- A computer for video processing connected to the camera and RSU

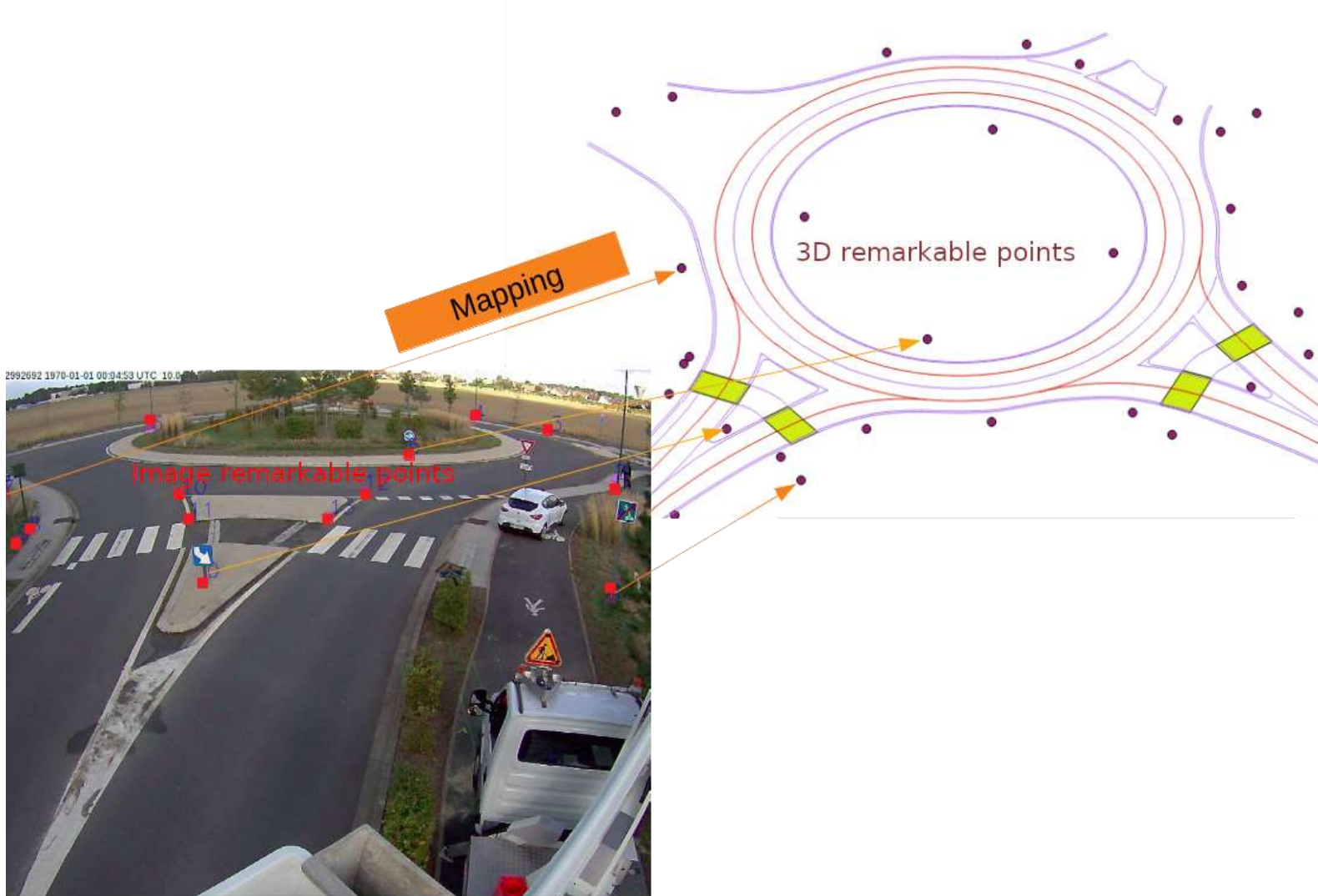
Video processing

- Acquisition of the video stream
- Detection of vehicles, pedestrians and two-wheelers in each image using Yolov5 with refined learning on our database
- Temporal tracking of detections using Deep SORT
- Detection of each entry of a pedestrian into a vehicle
- A warning message is broadcast using Collective Perception Message (CPM) format with GPS date and GPS position of the detected vehicle at 10Hz
- Intrinsic and extrinsic camera calibration is performed before processing

Detection of pedestrian entry



Camera calibration



- Intrinsic calibration performed before installing
- Extrinsic calibration after installing using remarkable points with known GPS position

Experiments

Site 1:

- Avenue Newton in Marne-la-Vallée, France
- Camera perpendicular to the road
- Parallel parking slots

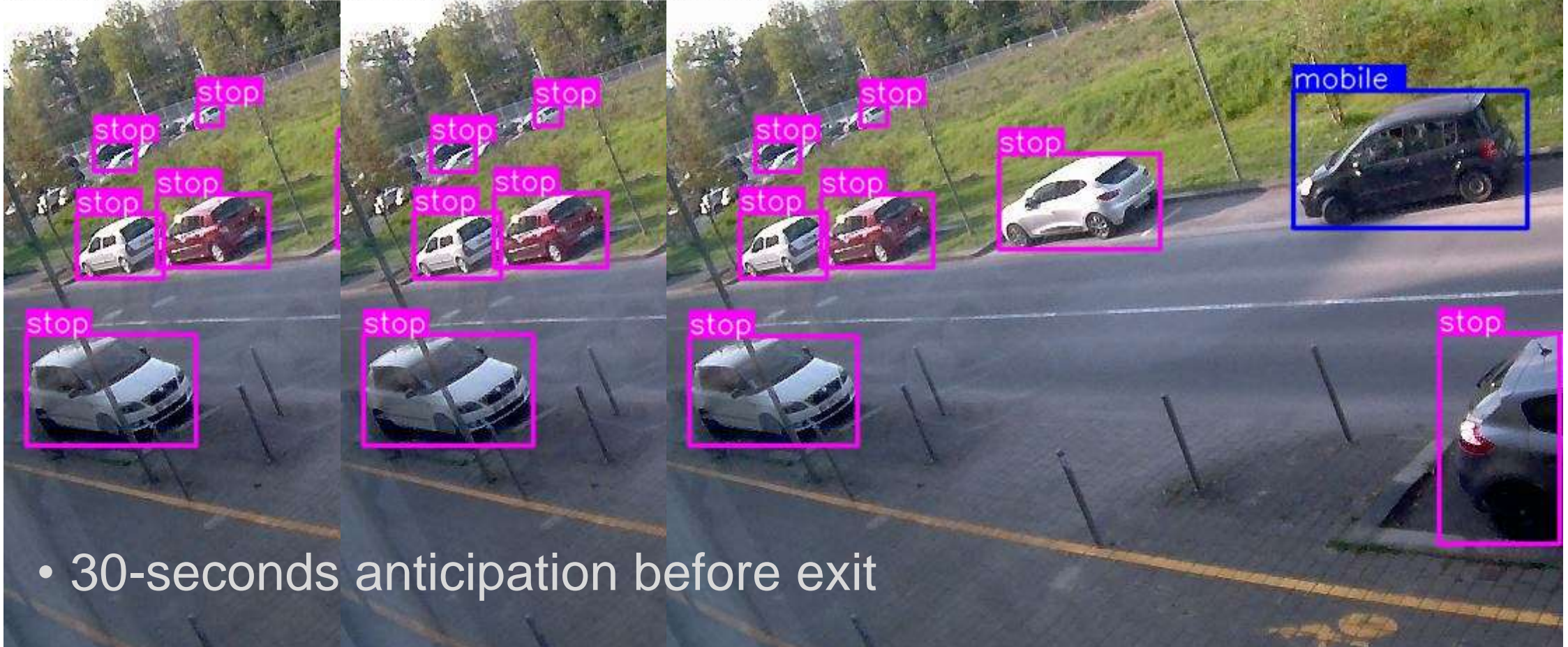
Site 2:

- Avenue Roumanille in Biot, France
- Camera parallel to the road
- Parallel and perpendicular parking slots



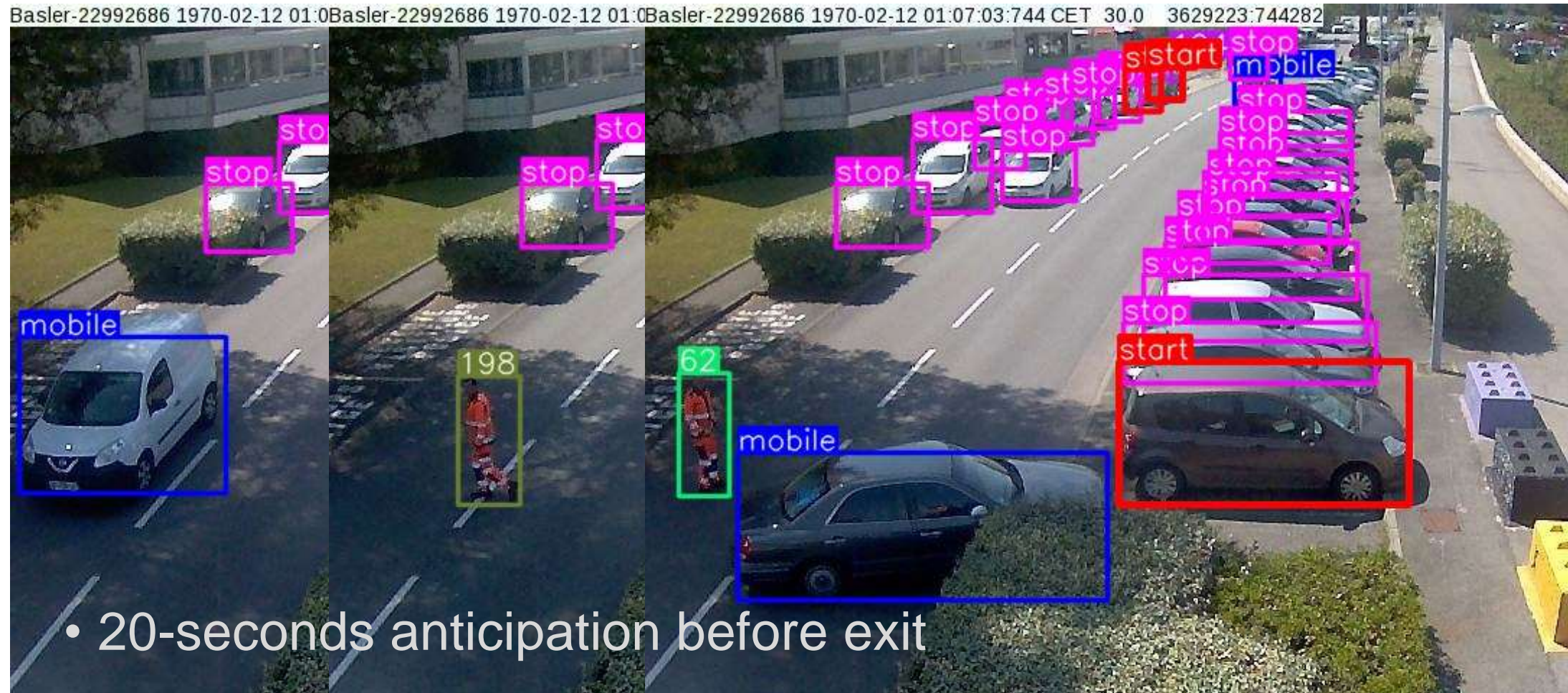
In Marne-la-Vallée, France

Basler-22992692 2022-04-15 19:08:5 Basler-22992692 2022-04-15 19:09 Basler-22992692 2022-04-15 19:09:38.CEST 1650042578:685418



- 30-seconds anticipation before exit

In Biot, CASA



- 20-seconds anticipation before exit

Anticipation time before exit

- Important time to estimate for the evaluation of the benefit of the proposed vision system
- Out of 20 detections, the average anticipation time before exit is 52 seconds with a standard deviation of 32 seconds
- Largely sufficient time to allow light processing and warnings sent with low frequency

Detection performances

- **Objective:** have 100% recall not to miss any exit even if it increases false alarms
- In **Marne-la-Vallée** (7.5h video): 58% precision and 100% recall, 64% precision with a variant
- Covered area of approximately 30 meters
- In **Biot** (7.5h video): 28% precision and 95% recall over 30 meters, 23% and 92% over 60 meters
- More non-detections on the perpendicular parking slot than on the parallel parking slot

Conclusions

- First assessment of the feasibility of an early detection of vehicle exits from their parking space using image processing
- The camera oriented perpendicular to the road gives the best performance over 30 meters
- Anticipating the exit by several seconds or even several tens of seconds allows full use of the warning messages by the communicant and autonomous vehicle

Future work

Untested cases:

- camera perpendicular to the road with perpendicular parking slots
- angle parking slots
- by night
- degraded lighting conditions
- poor weather conditions (fog, snow,...)

Thanks



Tentez l'expérience

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