



electric **V**ehicle **A**lert for **D**etection and **E**mergency **R**esponse

**Environmental Perception system  
& main interaction concept**

WP4, Maurice Cour

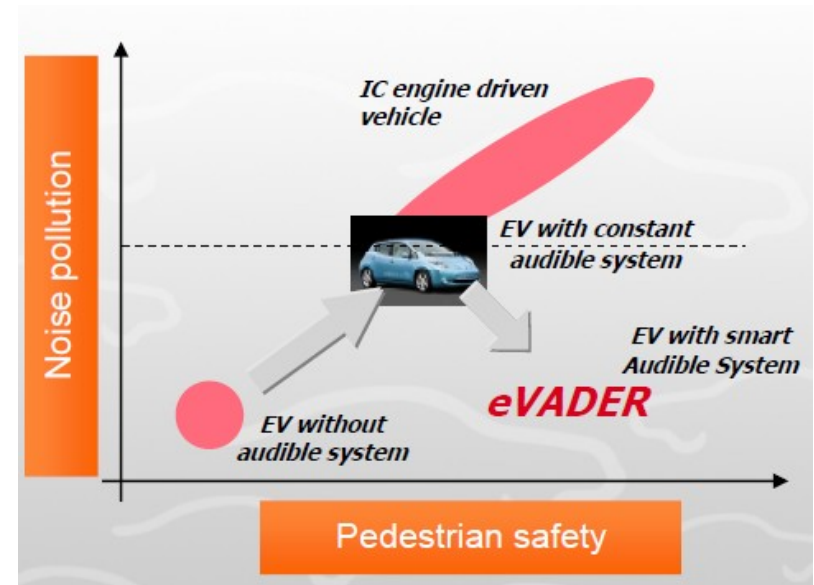
21/11/2013

## IC engine cars:

- Naturally noisy, even at low speed
  - Tires noise above 35 km/h
  - Engine noise becomes predominant below 35 km/h
  - Increase the ambient sound, annoyance for residents

## Silent cars:

- Hybrid cars
- Electric cars
- ... ICE low noise (!)
- Difficult to detect by ear, critical for Blind people



# eVADER concept

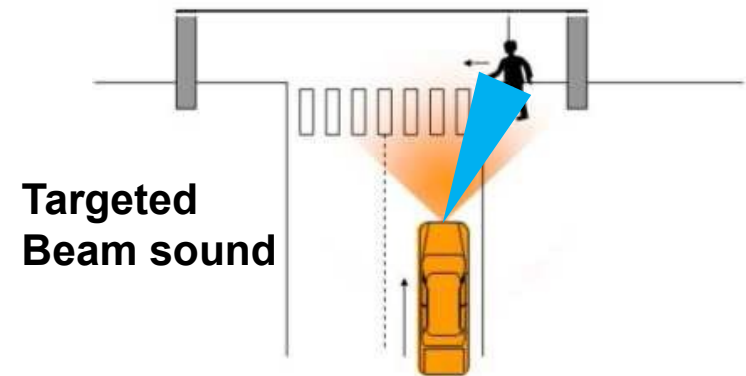
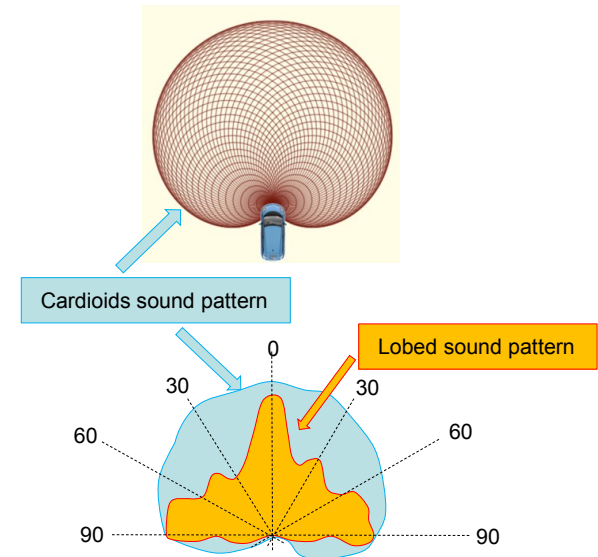
Car should be safe, but as “quiet” as possible:

- Over 35 km/h, no added sound
- Added sound below 35 km/h

Minimum added sound:

- Optimize type of sound (session I)
- Optimize level of sound (measures)
- Optimize directivity when possible: beam forming

- Require directional sound system
- Require data on vehicle environment



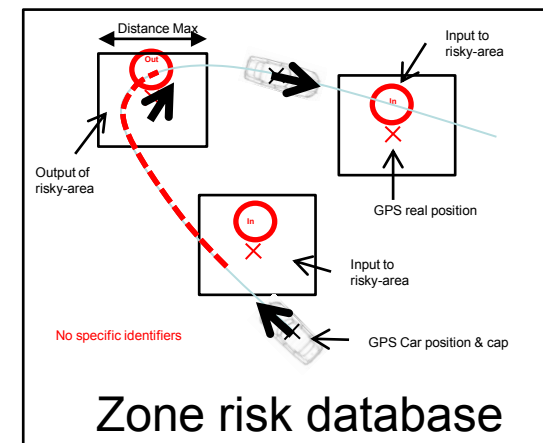
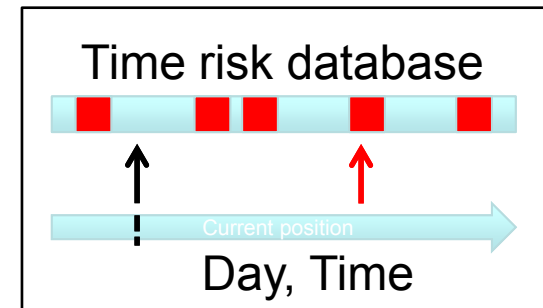
# Environmental perception sensors (1)

## 2 level approach:

- Low cost option: Location based
- Full functionality: VRU detection

## Location based System:

- Pushed by car manufacturers
- Based on GPS data (Time of the day, position)
- Determine a time related risk (vs. T database)
- Determine a zone related risk (vs. Z database)



# Environmental perception sensors (2.1)

## VRU detection:

- Determine precisely the position of Vulnerable Road Users (VRU)
- Based on stereo camera from Continental



Camera image

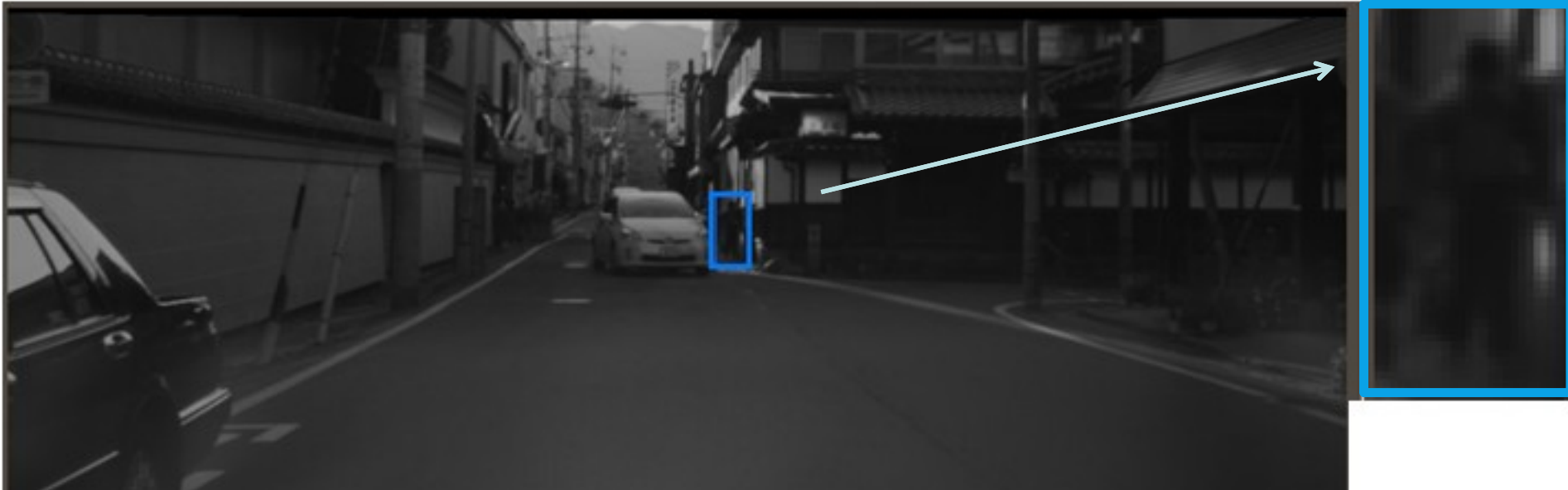


Pedestrian detection

## Environmental perception sensors (2.2)

### VRU detection limits

- Field of View ( $\pm 23^\circ$  ,  $\pm 10\text{m}$  Lat,  $35\text{m}$  Long), limited critical area
- Use of EBA Ped detection (reduce false positives)
- Various adverse conditions
- 85% confidence in 2013, in critical area

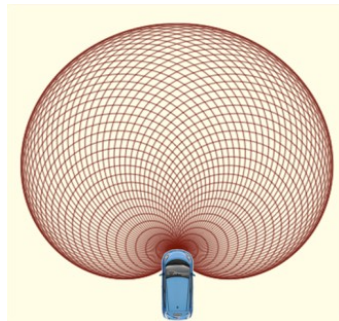


**Future → Increase these confidence limits, 95% by 2015, 99% by 2020?**

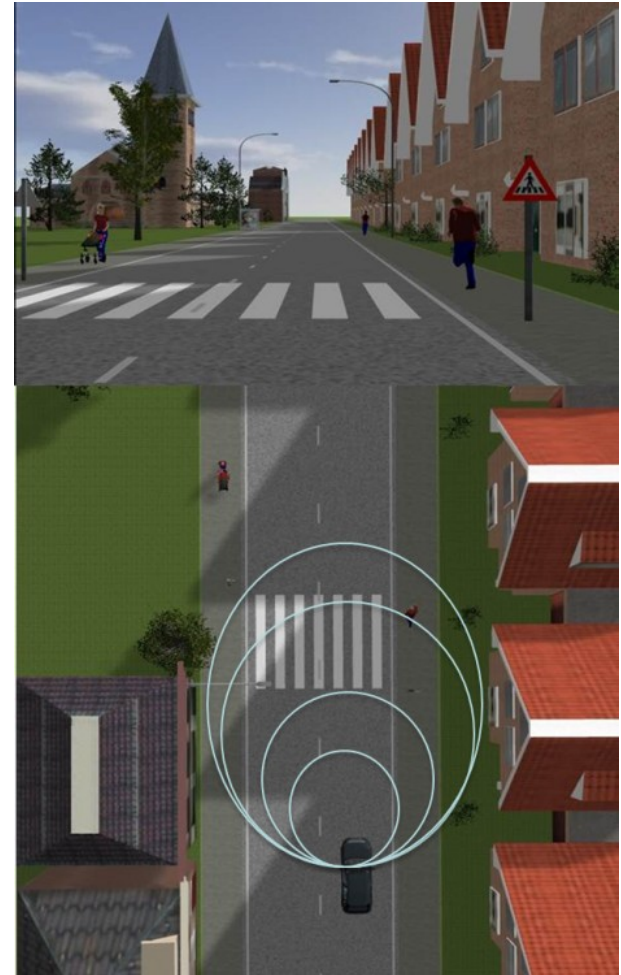
# Interaction concept base (low cost)

No precise knowledge about VRU's presence:

- **Omni-directional** sound
- Level reference from ambient
- Level adjusted from estimated risk



**3 levels: Low, Medium, High**



# Interaction concept full functionality

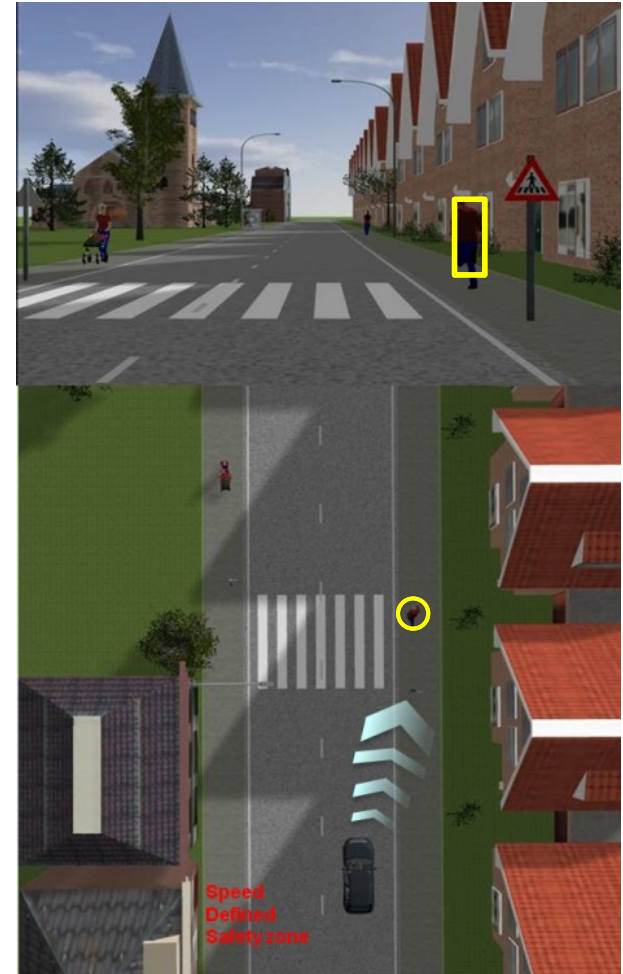
## VRU detected:

- **Beam** is directed towards VRU (or CoG)
- Internal warning can be generated
- Risk Estimation used to set external level

**2 levels: Medium, Highest**

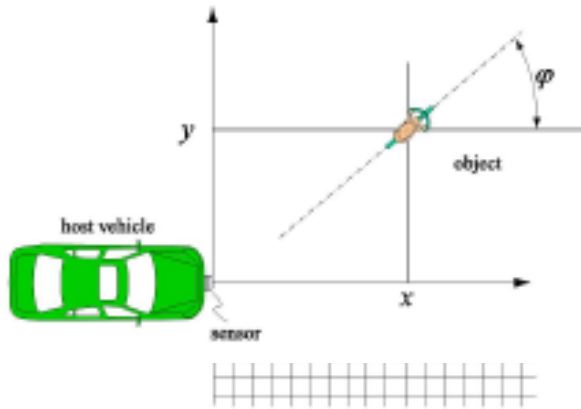
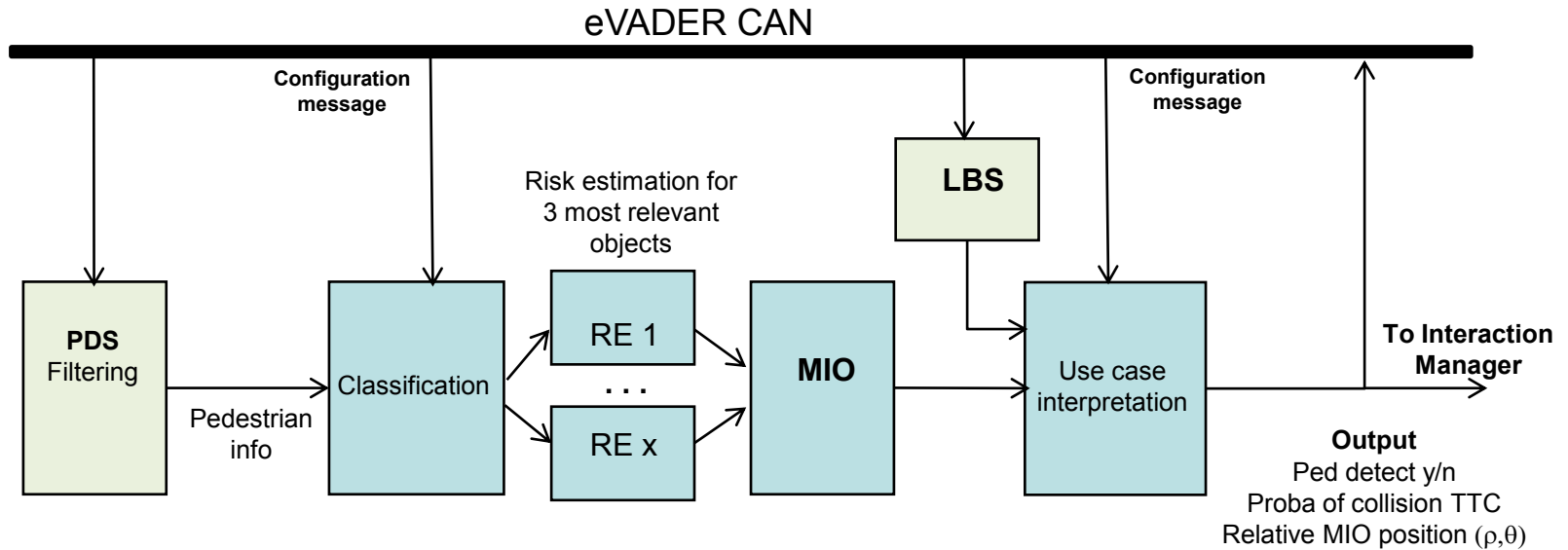
## Pedestrian sensor valid but no VRU detected

- Decrease one level estimated risk (thus sound level)
- Omni-directional sound
- Later (99,9% confidence achieved)... no sound





# Risk Estimation for detected VRU



From Ped data:

Quote the level of risk

(Tuning of risk level on course)

Classify according to Use Cases

Real-Time



AIT\_Visu\_SM

TNO\_RE\_SM



# Conclusion



2 levels environmental perception system

Adaptive interaction concept

Only simulation up to now

Real implementation on Leaf car is on going

# electric Vehicle Alert for Detection and Emergency Response

Thank you very much for your kind attention

