SAFESPOT

Cooperative vehicles and road infrastructure for road safety

Masters Thesis:
The Use of Spatial Databases in Cooperative Vehicle Systems

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SAFESPOT (cf. [1])

- Integrated research project (IP) co-funded by the European Commission
- **Objective:** Understand how intelligent vehicles and intelligent roads can cooperate to produce a breakthrough for road safety.
- **Aim:** Prevent road accidents developing a Safety Margin Assistant that detects in advance potentially dangerous situations and that extends in space and time drivers´ awareness of the surrounding environment.
- > 50 Partners (automotive, research, logistics, ..)

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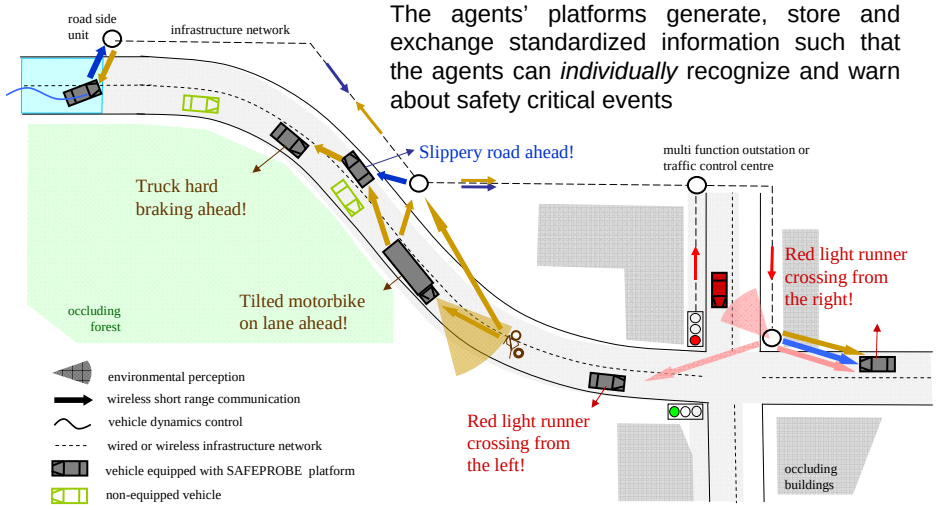
SAFESPOT Sample Use Cases



The agents' platforms generate, store and exchange standardized information such that the agents can *individually* recognize and warn about safety critical events

Motivation (1/2)

- "More than 40,000 deaths are caused by road traffic accidents in the European Union, the direct and indirect costs of which are estimated at AC 180 billion, or 2% of EU GDP. Moreover, the disparity between different Member States' road safety records is widening." (cf. [2])

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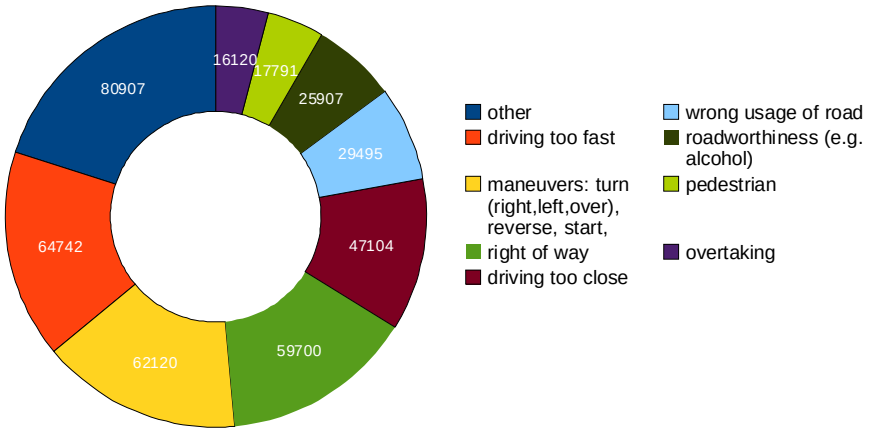
Motivation (2/2)

Accidents involving Casualties due Misbehavior of the Driver

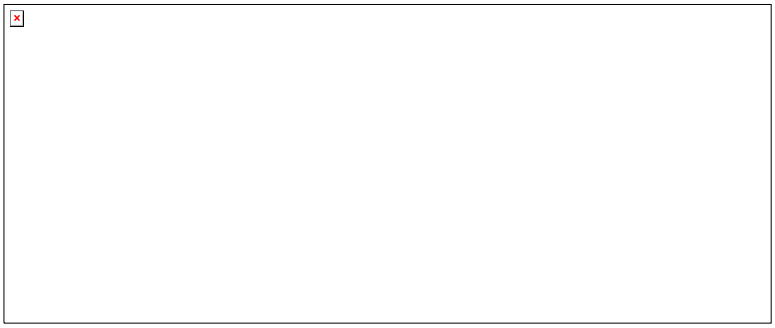


Source: Statistisches Bundesamt 2007 (cf. [3])

Establishing Road Safety (1/2)

- Pre-Crash
  - Preventive Safety: Prevent emergency situation altogether
    - ex.: ACC (Adaptive Cruise Control), LDW (Lane Departure Warning)
  - Active Safety: Avoid crash by giving driver maximum control over the vehicle
    - ex.: ABS (Anti-lock Braking System), ESC (Electronic Stability Control)
- Crash
  - Passive Safety: Reduction of fatalities
    - ex.: Vehicle Structure, Airbags
- Post-Crash: Support medical intervention

Establishing Road Safety (2/2)



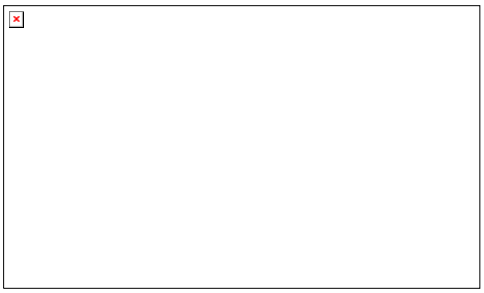
- Autonomous ADAS: Stand-alone Systems
  - Typically based on sensors, application logic, actuators
  - → Intelligent „Agent“ (cf. [4], p. 29)
- Cooperative ADAS: Add communication layer
  - → Multi-Agent System (cf. [5], p. 79)

Conceptual Design (1/2)

Conceptual Design (2/2)

- Local Dynamic Map (LDM)
  - Data store for dynamic in-car data
    - Vehicle dynamics (e.g. speed, position, turn indicators)
    - Topological linkage to digital road network
    - Digital map extension: High resolution maps enriched with ADAS-related attributes (e.g. reference tracks)
- Application Programming Interface (LDM API)
  - Management of data (create, delete, update)
  - Extended set of functions for information retrieval
    - Spatial functions (e.g. distance, intersection)
    - Topological functions (e.g. next road element)
- Concept is abstract, not tied to a particular technology

Implementation



- LDM
  - Relational Database Management System (RDBMS)
  - Spatial Extension (re-use functionality in LDM API)
  - → PostgreSQL / PostGIS
- LDM API
  - JAVA class library

Validation

- How to test implementation w.r.t.
  - Initial requirements (IR)
    - IR define functionality
    - Can be tested using component tests (e.g. jUnit)
  - Real world behavior
    - Lab test
      - Implement sample LDM application
      - Simulate real world
      - Validate implementation against simulation
    - Field test
      - Equip car with sensors, refinement component, LDM...
      - Lengthy and expensive
      - Validation of whole SAFESPOT architecture

End

•Thank you for your time!

Bibliography

[1] SAFESPOT Consortium. *SAFESPOT – Co-operative Systems for Road Safety 'Smart Vehicles on Smart Roads'.* Available from: http://www.safespot-eu.org (cited 22.10.2008)

[2] European Parliament. *European Parliament - News - Press service - Info - Road safety: European Parliament says more action needed.* Available from: http://www.europarl.europa.eu/news/expert/infopress_page/062-1938-015-01-03-910-20070112IPR01913-15-01-2007-2007-false/default_en.htm(cited 22.10.2008)

[3] Statistisches Bundesamt Deutschland. *Unfallgeschehen im Straßenverkehr 2006*. Available from: http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Content/Publikationen/Querschnittsveroeffentlichungen/WirtschaftStatistik/Verkehr/Unfallgeschehenstrassenverkehr2006,property=file.pdf(cited 24.10.2008)

[4] Michael Wooldridge. Intelligent agents. In *Multiagent Systems - A Modern Approach to Distributed Artificial Intelligence*, pages 27 – 78. Gerhard Weiss, 1999.

[5] Michael N. Huhns and Larry M. Stephens. Multiagent systems and societies of agents. In *Multiagent Systems - A Modern Approach to Distributed Artificial Intelligence*, pages 79 – 120. Gerhard Weiss, 1999.

[6] ICSE 2001. *Workshop on Advanced Separation of Concerns in Software Engineering at ICSE 2001.* Available from: http://www.research.ibm.com/hyperspace/workshops/icse2001/ (cited 22.10.2008)