

Evaluation of an adaptive warning system with help of a miniFOT - A pilot study

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Background and previous projects

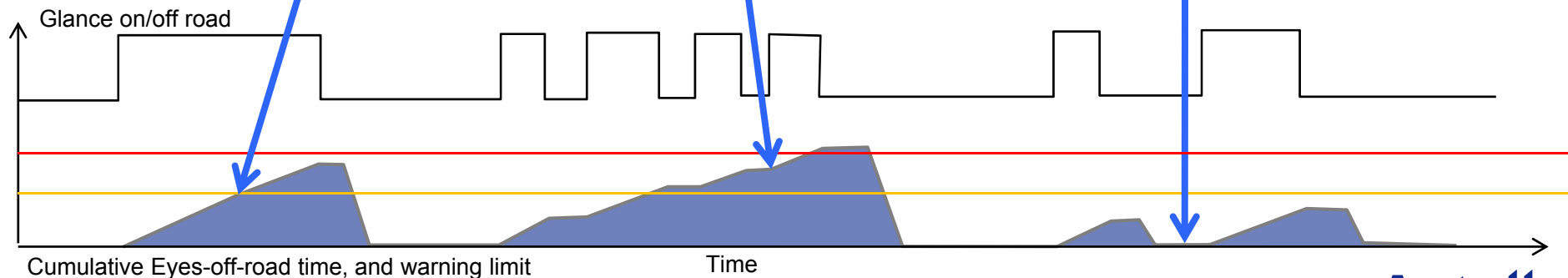
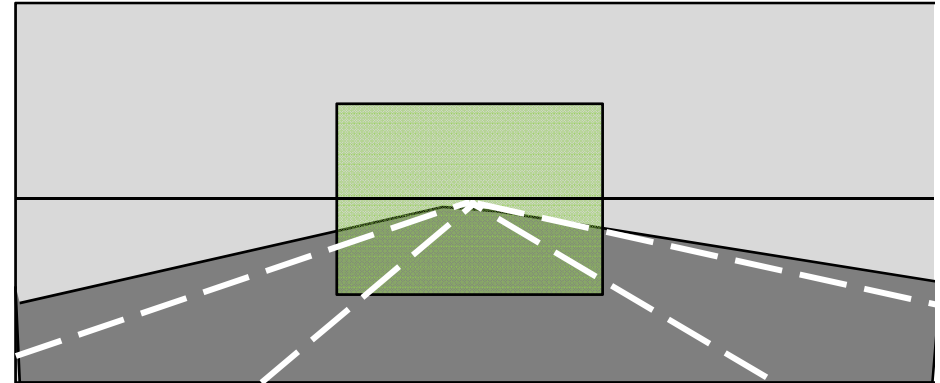
Final parts of a series of projects with focus on Drowsiness and Distraction detection

- Real road data (safety driver with dual command)
- Really sleepy drivers
- Vehicle instrumented with recording of:
 - All driving parameters
 - Remote eye tracking with eyelid detection
 - Driver physiology data (EEG,ECG,EOG)
 - Self assessed (KSS) and observer assessed driver sleepiness
- Over 250 hours in database

Visual Distraction Detection

An algorithm identifies status of 'eyes-on-road' to determine if the driver is visually attentive

A timer helps identifying both **single long glances** and **repeated short glances** away from road



State adaptive warnings

Given that we detect that a driver is distracted – what do we do?

Visual warnings? Auditory? Tactile?

Common driver assistance systems (LDW/FCW) have warning thresholds set with time margins adjusted for a distracted driver.

An attentive driver may be allowed to drive closer to vehicles in front or the road edges.

State adaptive warnings



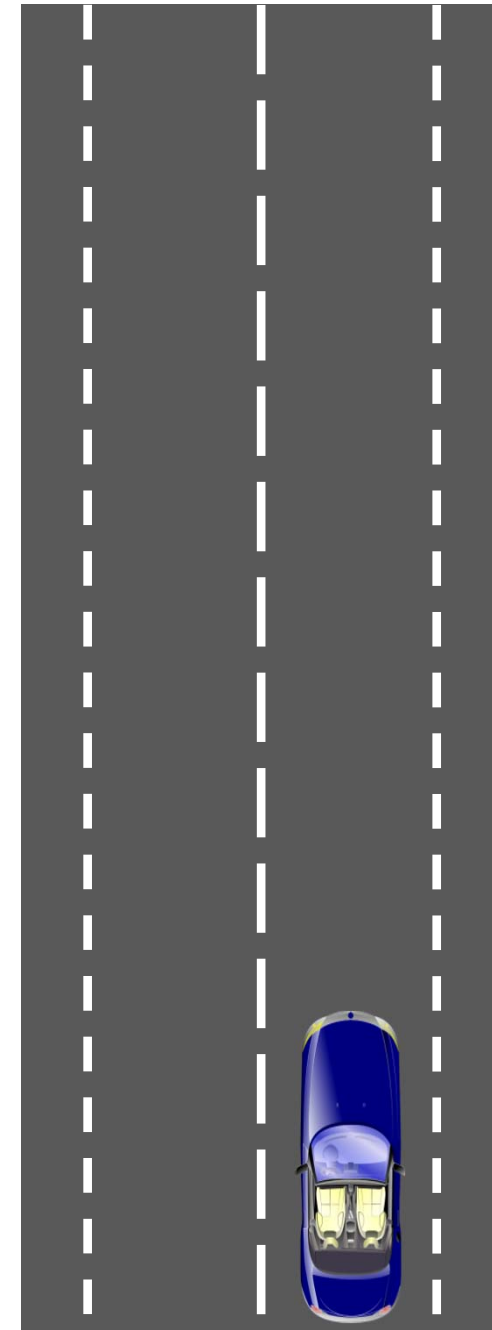
Lane Departure Warning:

- Inattentive: LDW will warn as default
- Attentive: LDW will warn at a later stage



Distraction alert:

- Default: Warn at N seconds Eyes-off-road
- Close to lead vehicle: Warn earlier than default
- Close to road edge: Warn earlier than default



HMI4AS – pico FOT

Equipped vehicle with adaptive warnings:
LDW, FCW, Distraction and Drowsiness

- 10 drivers, 1 week each
 - Commuting to work, min 30 minutes one way
 - Balanced order of conditions, first or last 2,5 days
 - Approx \approx 170-180 drives with data
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- Driver responds with:
 - 'Relevant / not relevant'
 - Short voice recording
 - Structured interviews and questionnaires at mid-week and vehicle return



Hypothesis and Expected results

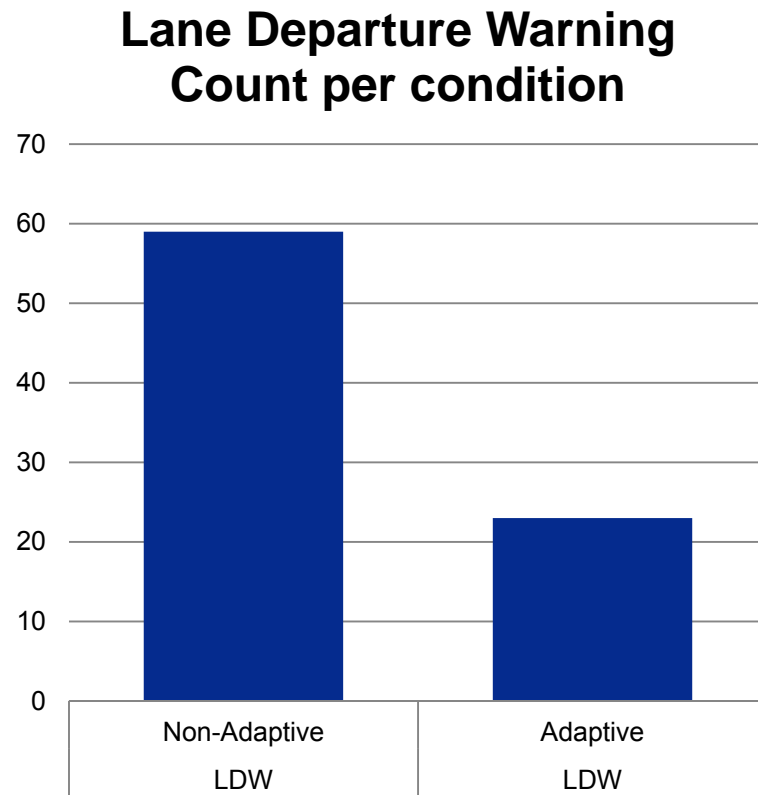
Hypothesis:

- “A reduced number of warnings, as a consequence of an adaptive strategy, will increase the drivers’ trust for a system”

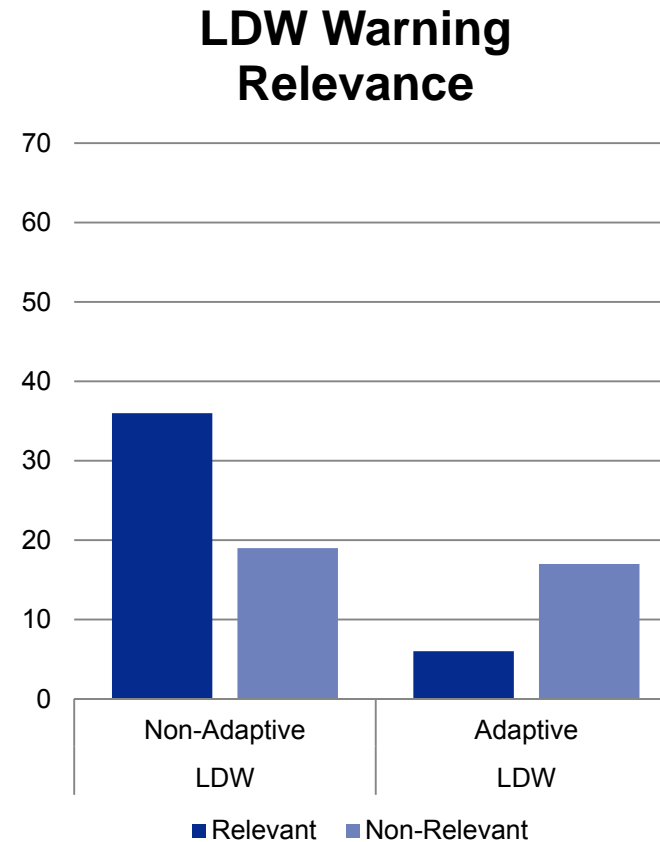
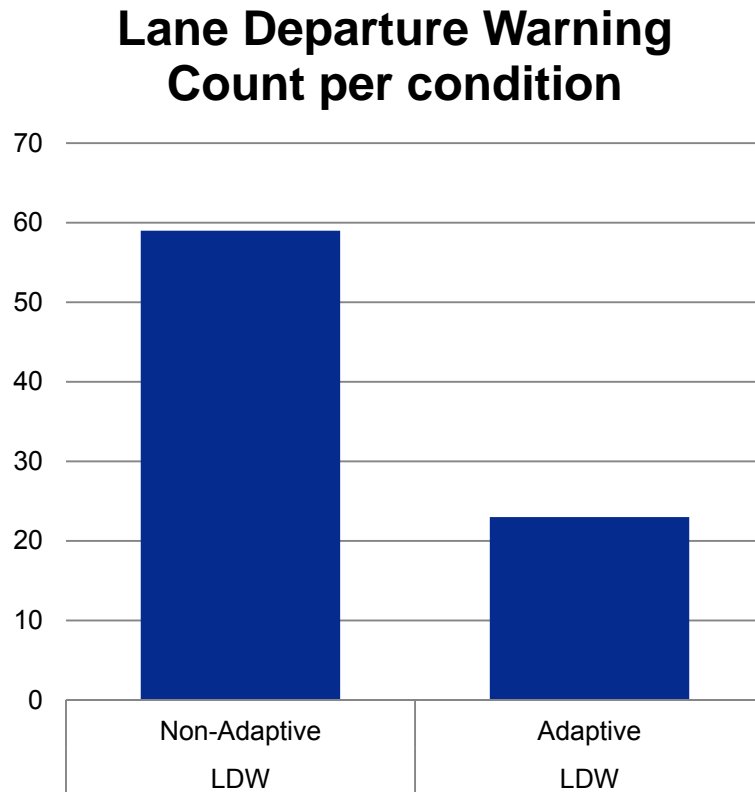
Expected results:

- Adaptive mode
 - Fewer warnings
- Non-adaptive mode
 - ‘Extra warnings’ will be regarded as irrelevant

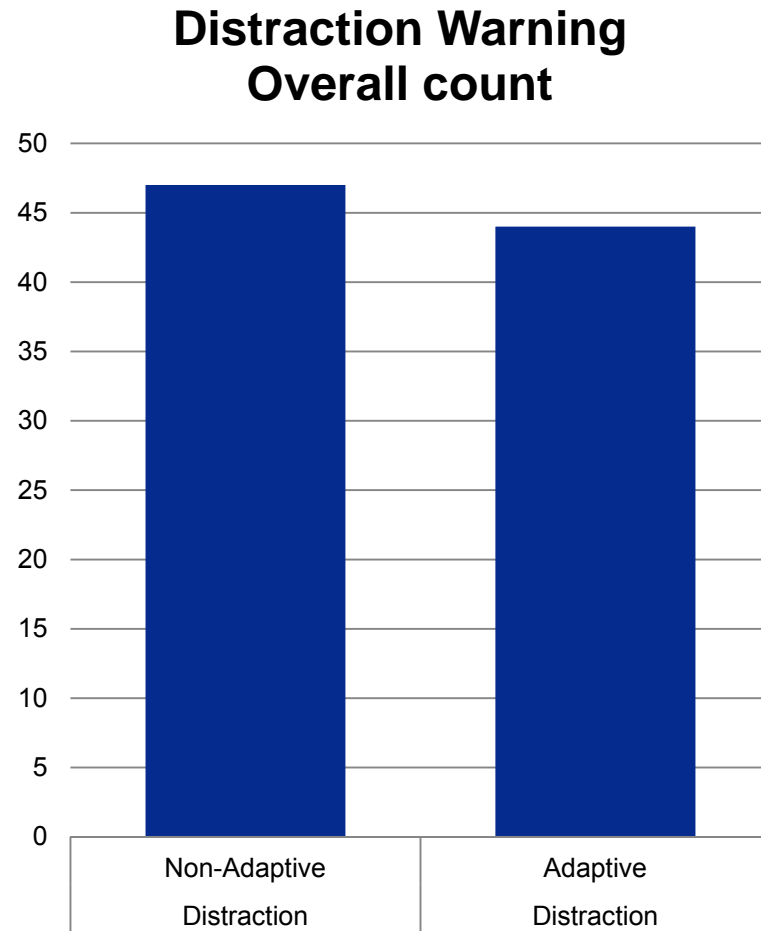
Results: Lane departure warning



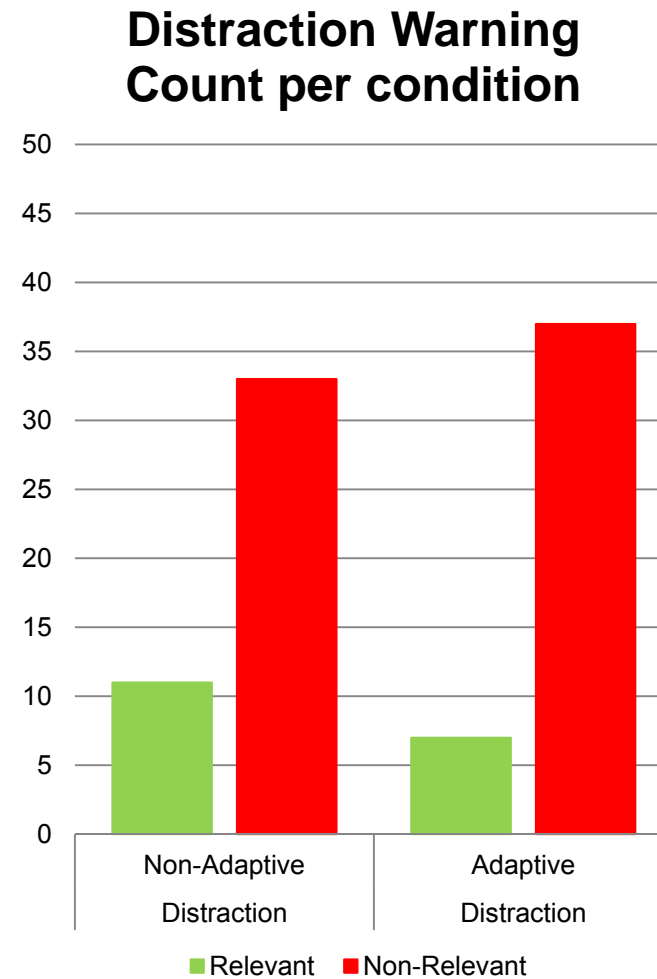
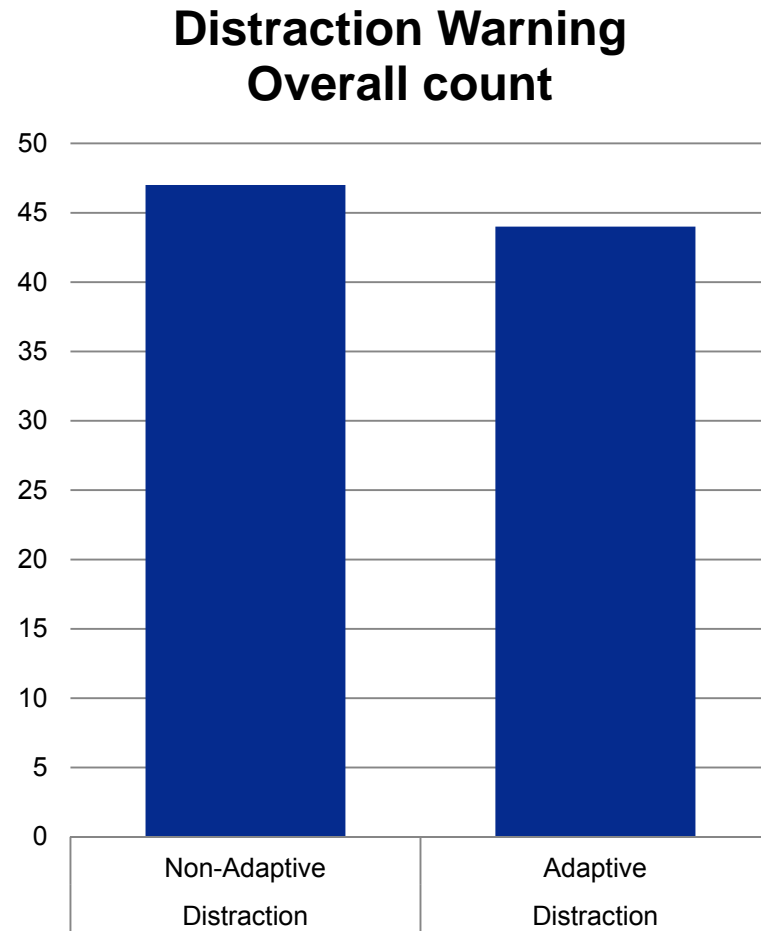
Results: LDW adaptive vs non-adaptive



Results: Distraction warnings



Results: Distraction warnings



'Relevance' judgements from touch screen input was verified by sound recordings and questionnaire results

Distraction, regarded as relevant:

- Relevant – I tested to look at a truck and not at the road, so...
- Whops, was a bit distracted by the phone.
- A little more attention to the rear than to the front.
- .. Probably ok, I accidentally took a good look to the side here.
- Looked at the stereo – may have been relevant

Distraction, regarded as not relevant:

- Doesn't feel like I'm inattentive – looking forward
- Looking at the road – doesn't feel relevant
- No, I'm looking ahead. I'm not inattentive. The system is doing wrong

'Relevance' judgements from touch screen input was verified by sound recordings and questionnaire results

Lane departure, relevant

- No, that was me testing if turn signals has any influence
- I cut the curve a bit, completely OK

Lane departure, not relevant

- Returning to the right lane, it was a passing lane
- Not relevant, not relevant
- I forgot my turn signal

Expected results

- Adaptive mode
 - Fewer warnings - **OK!**
- Non-adaptive mode
 - 'Extra warnings' will be regarded as irrelevant – **NO!**

Why?

- In order to control warning timing, warnings were generated using simple algorithms developed within the project
- Distraction detection was not robust enough
- Lane departure detection was not robust enough

→ Inconsistent warning behavior

However – overall impression with the system was positive!

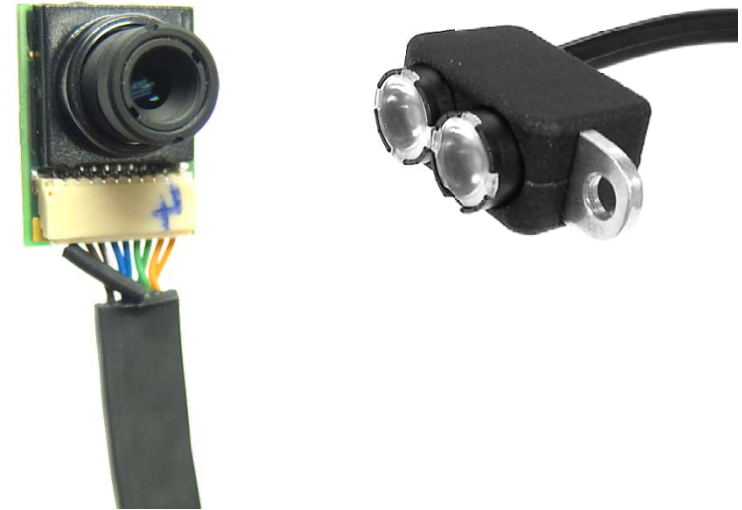
Different approaches to distraction detection

- Positive verification of Eyes-OFF-road
 - Large variation of driver actions/positions
 - High demands on detector at all gaze angles
- Positive verification of Eyes-ON-road
 - Less variation of driver actions/positions
 - Higher demands on detector at central angles
 - If no eye(s) detected → infer driver "eyes-off-road"



Summary and next steps

- Results – not as expected
- Back to the drawing board
- Implemented a more robust camera based distraction detection
 - Launch 10 car FOT test in april 2014
 - 10 drivers (in parallel)
 - Several months of data collection
 - Focus on real world robustness of detection
- Focus group study on automated cars
 - Younger drivers more positive



} → Results at DDI 2015?



Thank you for your attention