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A Data Collection Platform for Naturalistic Driving Studies (NDS): Evaluation of an In-vehicle Alert System for Level Crossings in Vehicles

Christian Wille[1], Neofytos Boufidis[2], Josep Maria Salanova Grau[2], Annika Dreßler[3], Jan Grippenkoven[3]
[1] *German Aerospace Center, Institute of Transportation Systems, Rutherfordstr. 2, 12555 Berlin, Germany*
[2] *Center for Research and Technology Hellas (CERTH) - Hellenic Institute of Transport (HIT) 6th km Charilaou-Thermi Rd., 57001 Thermi, Greece*
[3] *German Aerospace Center, Institute of Transportation Systems, Lilienthalplatz. 7, 38108 Braunschweig, Germany*
E-mail: [1&3] *name.surname@dlr.de[2] / Neofytos Boufidis <boufidisneo@certh.gr> / Josep Maria Salanova Grau <jose@certh.gr>*

Primary Research Question

Level crossings (LCs) as intersections of road and rail traffic are critical points due to the high severity of accidents involving all kinds of road users and trains. They are often protected with active safety systems like barriers or light signals.

However, in 2017, the European Union Agency for Railways registered a total of 467 LC accidents. In addition, the maintenance status of level crossings differs strongly across regions in Europe.

The European project SAFER-LC takes a multiperspective approach on researching, developing and assessing new methods to improve road and rail safety around LCs.

In Thessaloniki, an innovative ICT-based in-vehicle LC alert system was developed and tested by a taxi fleet with hundreds of vehicles. This poster presents the Naturalistic Driving Study (NDS) implemented on three of those test vehicles (taxis) to check how drivers react to the system.

The NDS - System

– Observation of drivers in their „natural“ environment
– Naturalistic Driving Study (NDS)
– Non-invasive and unobtrusive device
– Records data on everyday driving routes: way to work, shopping..

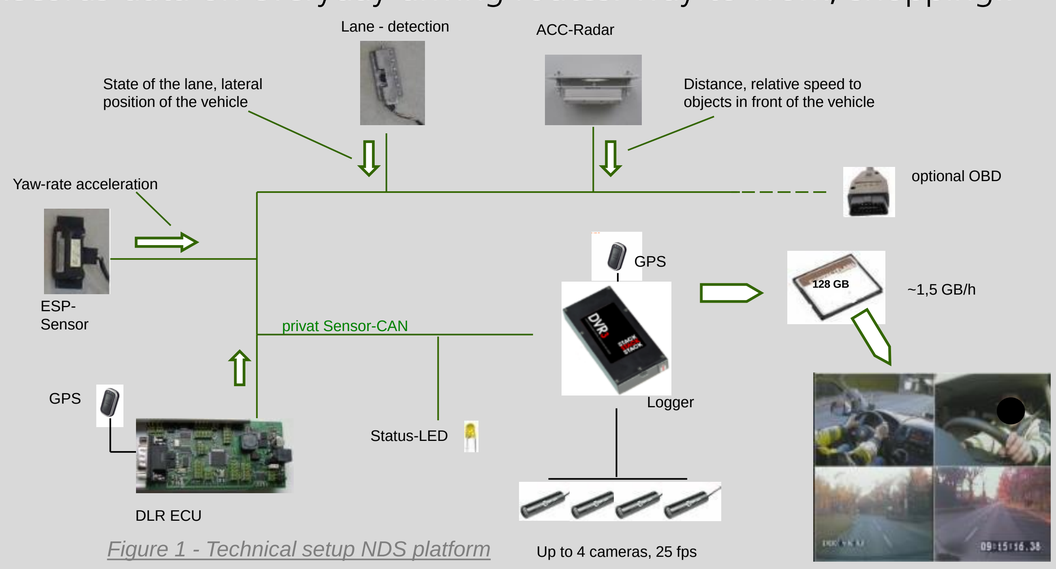

Figure 1 - Technical setup NDS platform

Evaluation Method

Use Case - The alert system in Thessaloniki

The operating taxis' and trains' locations are tracked for dispatching and monitoring purposes respectively. The alert system runs on a mobile device and detects cases of entrance in the critical polygon area defined around a LC. By processing the locations of trains, the system is also aware of trains approaching this LC and sends either an LC proximity (static warning) or train proximity (countdown to the estimated time of arrival) alert to the users driving towards LCs. The alert is provided through a dedicated popup window generated by the dispatching and navigation application already used by the taxis.

Data collection with the NDS Box

Three taxis were equipped with a naturalistic driving platform, consisting of cameras and a GPS sensor, to track the behavior of the drivers whenever they approach level crossings. The equipment was installed taking into consideration both the safety of all passengers and the privacy of customers. Driver and surroundings of the vehicles were recorded for a period of three months. During the first month the alert system was not activated, in order to collect baseline data. The safety relevant behavior of the drivers at level crossings before the implementation of the assistance system was compared to their behavior when the system was active.

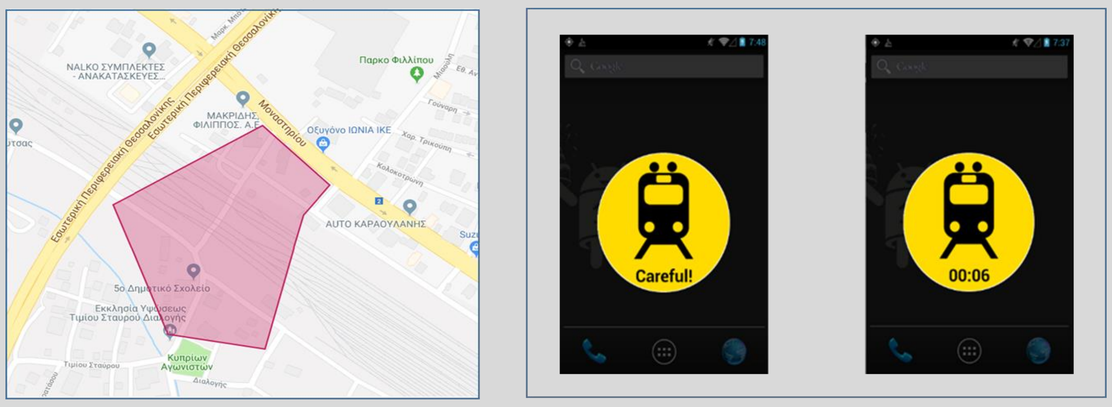

Figure 2 - The predefined polygon area around the LC located at 40°40'07.5"N, 22°53'09.4"E (left) and the pop-up alert of the safety system; static and dynamic countdown case (right)

Results and Conclusions

In order to evaluate the system, the recorded videos were for searched for LC crossings, with the help of additional floating car data recorded by HIT (Hellenic Institute of Transportation). The number of evaluable cases was reduced due to difficulties in recording (e.g. changes in camera focus and orientation, poor lighting conditions between 8 p.m. and 8 a.m., activation at times that did not involve LC crossings). We identified 16 evaluable cases that were part of the pilot. These crossings were analyzed for active search behavior in response to warnings as a sign of enhanced attention paid to LCs. Active search behavior was defined as observable head and/or eye movements (implying that the driver scanned the environment for trains), starting from the point in the video at which the first sign of the LC became visible, until the point at which the tracks were actually crossed. In four cases, the actual warning status could not be observed in the video, leaving 12 cases for analysis. In this small sample, the proportion of active search behavior was slightly higher after a warning than without a warning (3 of 5 vs. 3 of 7 observations; see Table 1). No instances of critical distraction by the warning were observed.

The NDS system offers a great possibility to get a close look on drivers' actions and reactions at LCs and the suitability of an in-vehicle warning system to enhance safe behavior. The sample results are consistent with the idea that warning systems can contribute to enhancing attention at LCs without causing undue distraction. However, the sample is very small and does not allow for a generalizable conclusion. We learnt that after installation and calibration, closer monitoring of system settings and use is necessary to achieve a more representative sample of LC episodes to analyze.

Table 1 – Active search at LC by warning condition

Warning	Active search behavior	No specific search behavior	Total
Yes	3	2	5
No	3	4	7
Total	6	6	12

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