Managing Driver Workload Using Continuous Driver Workload Assessment

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The last decades, the concern for the impact of our mobility system on safety, environment and congestion, has resulted in many innovations in vehicles and infrastructure. It is absolutely clear that the driver plays a crucial role in this. Pushing the throttle, not taking sufficient distance, taking risks on the road by aggressive driving behaviour are all factors being controlled by the driver. For that reason, engineers have tried to find innovative solutions by giving better support to the driver. Regarding safety, still over 80 % of all accidents are caused by human error, being primarily a result of poor recognition and inappropriate decision making. It is therefore remarkable that the type of driver and the driver state are hardly taken into account in these systems. We may distinguish between young drivers (responsible for 20 – 30 % of all driver deaths), elderly drivers (one out of five being older than 65 in Japan), truck drivers (combining logistic and driving tasks), etc. The driver state refers to mental workload experience (individual judgment of driving performance under possibly critical conditions), driver fatigue, alertness, drowsiness, driving skills, etc. It seems obvious that better (more effective) driver support may be obtained by adding driver state information to vehicle state data and information about traffic and road conditions, as input to the support system. This is referred to as DSE (Driver State Estimation) where we will emphasize on workload estimation.

The project ADVICE will take up the challenge to derive improved driver support systems, by taking driver workload into account. In more general terms (research question), ADVICE will explore the added value of workload estimation to interpret the actual driver ability to recognise traffic conditions and to make decisions, in order to contribute to a more effective driver support. The Workload is estimated from the context (such as various road characteristics, close by departure/destination etc.), from direct or indirect driver behaviour, e.g. the steering intensity and frequency, the observed use of throttle and brakes in relationship to traffic conditions, but also from physiological information (e.g. heart rate) and parameters describing the gain and delay of the driver response on changes in traffic and road conditions. The required workload estimation algorithm on the basis of driver observation can also be used to validate driver support systems in general with reference to workload, i.e. as part of a first generation standardized validation tool. Finally, by being able to derive workload data under varying traffic conditions, we can add information to a geographical map, to indicate locations with high workload expectation. These correspond to potential critical spots in the road network.

ADVICE will result in the following deliverables:

- A **Driver Support System** (a 'proof of principle' for a personalised user interface, on the basis of the monitored state (emphasis on workload, furthermore alertness, skills, …) of the driver. Extended with geographical information on high workload locations.
- A **Driver State Validator**, a first generation standardized research tool to validate Driver Support Systems in instrumented vehicle (field-) tests and naturalistic driving studies.

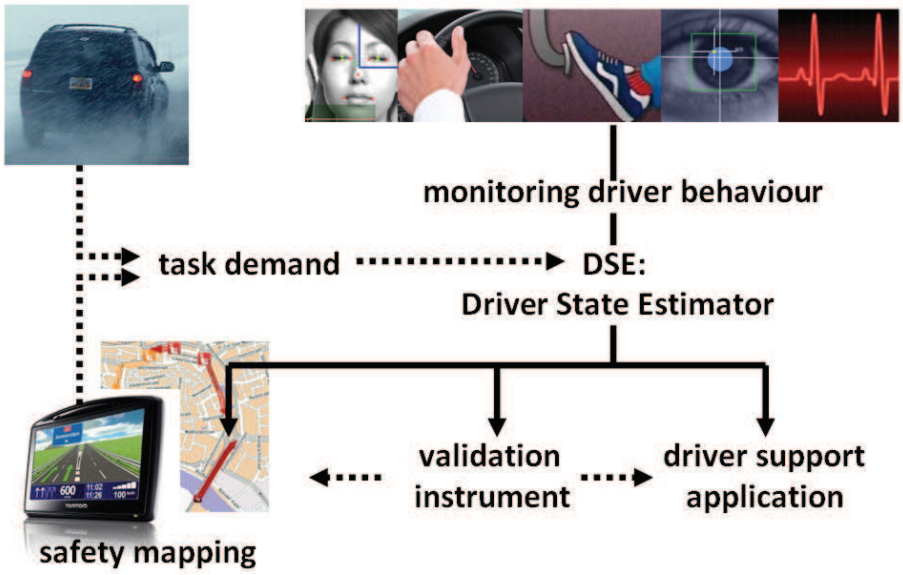

Figure 1. ADVICE system layout.

See figure 1 for a schematic layout of the proposed system. A consortium of organisations, with partners which are well recognised authorities in their specific field, has been formed to execute this project: TomTom, Noldus Information Technology, TNO, Delft University of Technology and the HAN University of Applied Sciences (project- and research management). In addition, specific associated SME partners have joined the ADVICE team, bringing in valuable knowledge and tools related to driver observation and data acquisition. Within the consortium, the industrial partners will focus on producing feasible and practical results, whereas TNO, HAN and Delft University will support this work through their in-depth knowledge, identification algorithms, and validation through experiments in-door (driving simulation), out-door (instrumented vehicle, under naturalistic conditions), software-in-the-loop and hardware-in-the-loop. ADVICE will use results of related previous projects such as the DRIVOBS project (methods for driver observation in car simulators) and the Dutch SPITS project, with a focus on affordable and open solutions for an Intelligent Transport System.

The presentation will focus on the need to adapt in vehicle information systems to driver state, and on foreseen affordable methods to estimate driver state.