D4.4 A flexible driver-machine interface for real-time warning interventions.

Interview with André Lourenço

Keeping drivers in the Safety Tolerance Zone (STZ), that is what i-DREAMS aims to do. To be able to do so, the system needs to monitor and assess what is going on while driving. The materialization of this concept implies that the infrastructure has both a monitoring as well as an intervention dimension. The monitoring dimension takes into account the driver background and real-time risk indicators associated with the driving performance, as well as the driver's state and the driving task complexity indicators. A safety-oriented intervention system will be responsible for effectively informing or warning the driver in real-time. This intervention system is to be conducted by the intervention device, providing visual and sound alerts to the driver, as well as other information about the state of the STZ. Additionally, for certain situations, the intervention device will give specific information to the driver, and also act as an aggregator of information, e.g. identification of the driver. The scope deliverable 4.1 is to describe this intervention device.

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Hi André, how are you? As responsible author for this deliverable you agreed to talk to me about the intervention device. Thank you for that. What can you tell me about this device?

André: *"I would first like to explain a bit on ADAS and the intervention systems that are available on the market. So first, I would like to open up the scope a bit before I get into the device that we created and use in our project. Is that ok?"*

Absolutely, I'm all ears!

André: *"You have probably already heard about ADAS, which stands for 'Advanced Driving Assistance Systems'. These systems have been developed to assist drivers in their driving task and are evolving very rapidly. Ultimately will allow "automated driving". These systems are typically categorized depending on the vehicle's level of autonomy, where level 0 implies no autonomy. Level 1 represents the lowest level of automation which is most common in the majority of the existing fleets. And then we have the newer generation of systems in level 2 that have on-board ADAS. Here, vehicles can already steer, or break without human intervention. However, the driver is still required in the driver's be seat and needs to be able to take control at any time. These systems are considered active ADAS. To add them to vehicles, a special homologation is required, which typically implies that these ADAS are already built-in, in the vehicles. In i-DREAMS we aim for an aftermarket option which creates passive interventions, only to inform the driver about his/her condition, about the road and the vehicle."*

And what system did you use specifically then in i-DREAMS?

André: *"We have studied different types of sensors that fit the proposed approach, and we have chosen Mobileye, a collision avoidance system that provides Forward Collision Warnings, Lane Departure Warnings and Pedestrian and Cyclist Collision Warnings. Additionally, the built system has the option of monitoring the driver based on his/her physiological signals using CardioWheel or a wearable."*

What does Mobileye measure specifically to be able to provide those warnings?

André: *"Mobileye bases its warnings on the Time To Collision (TTC) parameter which is based on an image analysis of a single camera. Another characteristic of the environment that Mobileye can collect is the information regarding road signs, especially speed limits. Mobileye uses it to display the current speed limit and provides warnings when that limit is exceeded."*

So, can we consider Mobileye as the intervention device then?

André: *"Mobileye can be seen as an intervention device, but it does not provide all the information that was required for i-DREAMS, where we wanted to go further. We wanted to tailor the interventions to the status of the user – like a smart ADAS. So, we used Mobileye as a sensor for measuring that. We then integrated it with other sensors, and used our STZ algorithm to create different "smart" interventions that are shown on a rectangular small screen, that we call our i-DREAMS intervention device."*

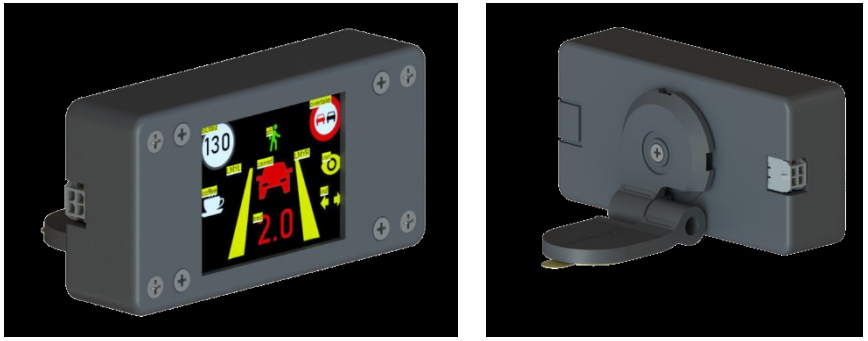

Figure 1: Front and back views of the i-DREAMS intervention device

Is this display an off-the-shelf product like Mobileye, or was it specifically designed for i-DREAMS?

André: *"It was specifically made for i-DREAMS. It is a complete Human Machine Interface (HMI) solution that can be easily programmed to show a wide range of visual warnings in full colour. The device combines a touch-sensitive LCD screen with an onboard controller and memory. This means it does not require a video signal. Instead, it can be programmed with a custom routine ad pre-defined pictures and screens. This makes the device compatible with a wide range of other controllers and devices, including the CARDIOID gateway, known as the brain of the i-DREAMS system. The fact that it can run its own routine is especially important for i-DREAMS during the start-up phase, right after the vehicle ignition switch is turned on. It will then immediately show a message to the driver to confirm his/her ID before the bootup sequence of the i-DREAMS gateway is fully completed."*

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OK, so now we know what the intervention system does and for what purposes it can be used. Can you elaborate a bit on everything that can be shown on the display?

André: *"Of course, then we are talking about the Graphical User Interface (GUI). We can distinguish two different sections: firstly, the driver identification and settings and secondly the real-time interventions. After turning on the ignition switch, the driver will be automatically prompted with a message to confirm or change his/her driver ID. After the driver ID has been confirmed and communication with the i-DREAMS gateway has been established, the intervention device will display an interface that provides the driver with real-time information and, if necessary, displays visual real-time interventions."*

When you talk about that driver identification, how is this visualized on the intervention device?

André: *"After turning on the ignition, the driver will see a message like in Figure 2. The driver has the option to confirm his/her identity, which will trigger a welcome screen, or decline, which will bring up a list of drivers that are known to the current vehicle. Selecting one of the IDs from this list also triggers the welcome screen, while pressing the "other" button confirms that the driver is not enrolled in the i-DREAMS program, triggering a message that warns the driver that the intervention device is about to be shut down.*

Once the welcome screen is displayed, the intervention device waits for the i-DREAMS gateway to boot up. When communication has been established between the i-DREAMS gateway and the intervention device, the real-time interventions GUI will be loaded. Otherwise, the intervention device will be deactivated. Another feature of the system which is helpful for professional drivers is that the identification of the driver can be automated by reading the Tachograph using the so-called FMS protocol."

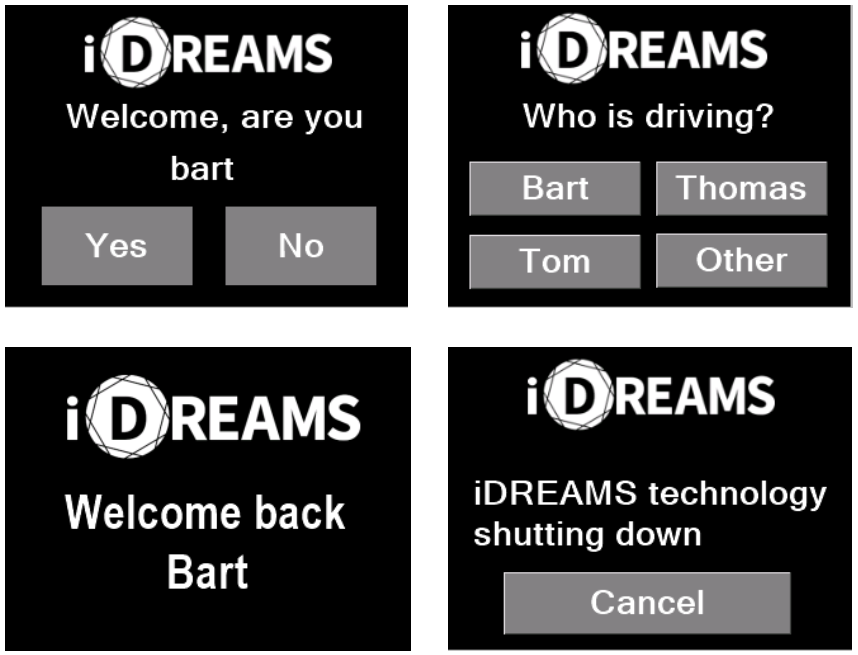

Figure 2: Driver identification screens

What do the real-time interventions look like?

André: *"That all depends on the intervention of course. We use visuals to reflect the results of all the different monitoring systems. Each symbol is linked to a specific monitoring system (headway, lane keeping, fatigue…) and different colours are used to show the current status or phase and nudge the driver to stay within the normal driving phase of the Safety Tolerance Zone. We depicted this in Figure 3."*

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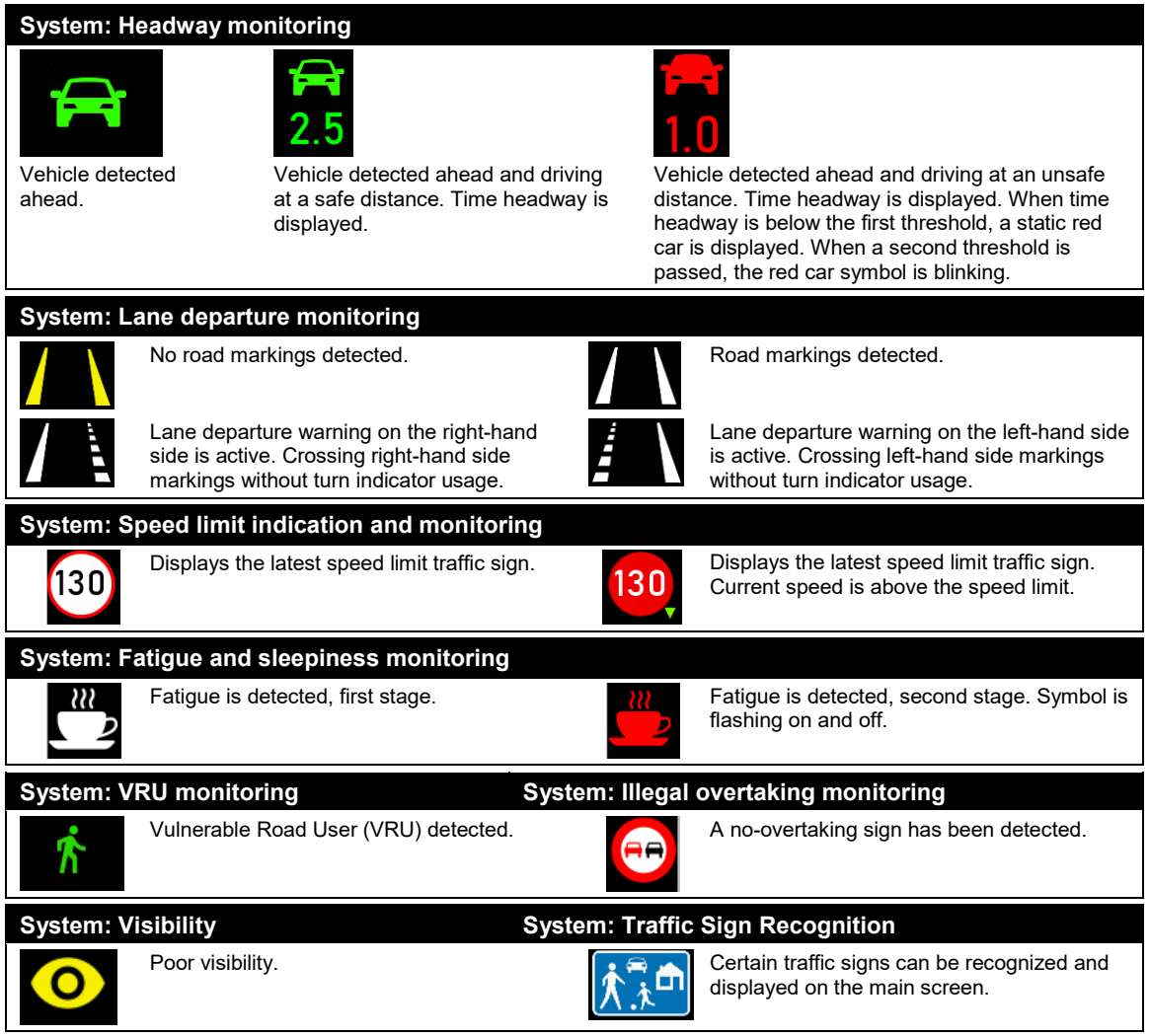

Figure 3: Examples of symbols per monitoring system

And how do you distinguish between regular warnings and time-critical warnings?

André: *"Interventions that are time-critical demand immediate action. They therefore have a dedicated view and take over the entire screen. Usually, they are also accompanied by an auditory alert. Other changes, such as a change of speed limit, also trigger a temporary pop-up on the entire screen, unless more important information is currently available."*

The traffic sign recognition, how does that work exactly?

André: *"Well, wat is recognized, is displayed. We use Mobileye for the recognition. The Mobileye system can read certain traffic signs and supplementary sign (if present). Whenever a new traffic sign is read by Mobileye, it will be shortly displayed on the intervention device on the full screen, provided that no safety-critical conditions are active. This step took an extra effort because sometimes Mobileye gets confused when more than one speed limit indication is present. Therefore, further post-processing, using OpenStreetMaps information, was carried out."*

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How does the intervention device take into account the different phases of the STZ?

André: *"To activate and deactivate the different screens, images, and warnings, in response to the changing phases of the STZ algorithm, the display needs to send and receive commands from the CARDIOID gateway. To this end we developed a software controller module in the gateway. This module receives messages from the STZ algorithm, speed limit information, and traffic signs, which then activate the appropriate visualizations on the display. This controller module also triggers the warning sounds associated with each intervention situation, through the use of a speaker on the gateway."*

Well André, it sounds like you did a great job developing this device. Thank you for taking the time to explain this to me.

Edith Donders

i-DREAMS DisCom Manager

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Deliverable 4.4 is part of WP4:

Technical implementation

Download the report here

Researcher in the spotlight

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Graduated as *Electrotechnics and Computers engineering in 2001, master in 2005, and PhD in 2014, all in the same field.*

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Tasks in i-DREAMS: *Mainly WP4 – the development of the i-DREAMS full-stack*