Development Platform for Safe and Efficient Drive

Definition of a general integrated HMI solution

Deliverable n.	D33.2 –Definition of a general integrated HMI solution		
Sub Project	SP3		
Work package	WP33	Application Needs	
Task n.	33.3		
Authors	DESERVE consortium		
File name	DESERVE_D332_ Definition of a general integrated HMI solution.doc		
Status	Final		
Distribution	Public (PU)		
Issue date	21/10/2013	Creation date	15/10/2013
Project start and duration	1st of September, 2012 – 36 months		

ARTEMIS

REVISION AND HISTORY CHART

VER.	DATE	AUTHOR	REASON
0.1	15/10/2013	RE:LAB	1st release
0.2	18/10/2013	DAIMLER	Peer review
F	22/10/2013	RE:LAB	Final version

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

ABBREVIATION	DESCRIPTION
ACC	Adaptive Cruise Control
ADAS	Advanced Driver Assists Systems
API	Application Programming Interface
CW	Collision warning
DAS	Driver Assistance System

ECU	Electronic control unit
ESoP	European Statement of Principles on HMI
GPS	Global positioning system
GUI	Graphical User Interface
HMI	Human Machine Interface
HUD	Head up display
IPAS	Intelligent Parking Assist System
ISO	International Organization for Standardization
LDWS	Lane Departure Warning System
NHTSA	National Highway Traffic Safety Administration
OEM	Original Equipment Manufacturer
PTW	Powered Two wheelers
SDK	Software Development Kit

EXECUTIVE SUMMARY

The main objective of WP33 is the definition and the analysis of HMI needs in order to define a general integrated HMI solution to be integrated within the DESERVE platform. Along these lines this deliverable present the results of the activities performed in relation to task 33.3 Definition of a general integrated HMI solution of the DESERVE description of work.

Nevertheless, at the time of writing this deliverable, the HMI architecture of the DESERVE solution is not yet defined. Therefore the main focus of this deliverable is analysis of main HMI solutions available on the market for DAS identified in WP 11 and the elaboration of design guidelines for the final DESERVE HMI solutions.

Further updates during the course of the project and in particular of the demonstrator development activities may happen as appropriate and useful. This might have a significant impact on the HMI needs and requirements of the demonstrators. Moreover, the list of HMI needs and requirements for the DESERVE demonstrators is not yet complete at the time of the elaboration of this deliverable.

These updates will be reported in Deliverable 34.1 HMI solution design, which is the logical follow up of this report.

1. INTRODUCTION

1.1 Objectives and scope of the document

The main objective of WP 33 is the definition and the analysis of HMI needs in order to define a general integrated HMI solution to be integrated within the DESERVE platform.
Along these lines this deliverable present the results of the activities performed in relation to task 33.3 Definition of a general integrated HMI solution of the DESERVE description of work.
This task states: “by starting from the requirements and specification defined in task 33.2, the definition of the architecture for a general integrated HMI solution will be performed. It will include several concept proposals concerning all possible hardware and software modules it may be composed of, in order to consider the widest range of solutions to be developed and implemented in WP 34. The architecture will be also defined in order to deal with the lack of some elements (such as sensors and actuators) or their degradation, without invalidating the overall system.”
Nevertheless, at the time of writing this deliverable, the HMI architecture of the DESERVE solution is not yet defined. Therefore the main focus of this deliverable is analysis of main HMI solutions available on the market for DAS identified in WP 11 and the elaboration of design guidelines for the final DESERVE HMI solutions.
Further updates during the course of the project and in particular of the demonstrator development activities may happen as appropriate and useful. This might have a significant impact on the HMI needs and requirements of the demonstrators. Moreover, the list of HMI needs and requirements for the DESERVE demonstrators is not yet complete at the time of the elaboration of this deliverable.
These updates will be reported in Deliverable 34.1 HMI solution design, which is the logical follow up of this report.

1.2 Structure of the deliverable

This deliverable provides first of all a reminder of the main DAS groups identified in WP 11, which serve as a basis for further work within the DESERVE development framework.
The next paragraphs describe in more details the purpose of each DAS group and provide examples of the most common HMI solutions already available on the market for each of this

DAS. This state-of-the art analysis, which does not aim to be exhaustive, is intended to be propaedeutic for the definition of the DESERVE HMI solution.

The following chapter focuses on the elaboration of design guidelines for the final DESERVE HMI solutions.

2. DESERVE DRIVER ASSISTANT APPLICATIONS AND HMI: A STATE OF THE ART

In the subproject WP11 - Application needs, an application database was created, that identified 10 groups of DAS with 33 applications that are currently available or will be soon introduced in the automotive market. This elaborated DAS database will serve as a basis for the DAS applications addressed, investigated and finally selected for further work within the DESERVE development framework. It should be noted that not all of the DAS applications could be dealt with in the same manner and working depth throughout the project and a selection to a few demo cases, that will be examined and developed in more detail in WP4, is therefore needed. The database content is divided into 10 main DAS groups:

- Lane change assistance system
- Pedestrian safety systems
- Forward/Rearward looking system (distant range)
- Adaptive light control
- Park assistant
- Night vision system
- Cruise Control System
- Traffic sign and traffic light recognition
- Map supported systems (Note: only DAS scope, no driver information)
- Vehicle interior observation.

The following table presents an initial list of HMI features (i.e. type of message for users) which will be tested in relation of the main DAS groups.

Table 1 initial list of HMI features which will be tested in relation of main DAS groups

	HMI interfaces					
Driver Assistant Application Groups	HMI warnings	Acoustic	Visual	Haptic	On/Off commands	Other
Lane change assistance system	x	x	x	x		
Pedestrian safety	x	x	x	x		

systems						
Forward/Rearward looking system (distant range)	x	x	x	x		
Adaptive light control			x		x	
Park assistant	x	x	x			
Night vision system	x		x			
Cruise Control System	x	x	x		x	
Traffic sign and traffic light recognition	x		x		x	
Map supported systems (Note: only DAS scope, no driver information)	x				x	
Vehicle interior observation	x					

The next paragraphs describe in more details the purpose of each DAS group and provide examples of the most common HMI solutions already available on the market. This state-of-the art analysis, which does not aim to be exhaustive, is intended to be propaedeutic for the definition of the DESERVE HMI solution.

2.1 Lane Change Assistance System

This category of DAS includes Lane Departure Warning System, Lane Change Assistance System, Overtaking Assistance System, Blind Spot Detection.

Lane Departure Warning System uses sensors behind the front bumper, three on each side, to monitor the lane markings. When the sensors notice that the car is drifting across the lane markings and the indicators are not in use, usually a computer sends a signal to a pair of vibration devices, on each side of the driver's seat.
If the car is drifting to the right, the driver feels a vibrating signal in the right side of the seat and vice versa. The warning allows the driver to take immediate actions and steer back

to the lane. The system is activated by the push on a button and can also detect yellow, red and blue lane markings which are used in some European countries see figure.

Figure 1 - LDW activation button

LDWS are available in many cars now. An example is Audi A4 lane assist. The steering wheel vibrates once only in order to alert the driver when the vehicle is approaching or crossing a detected lane marker. A second warning is only given if the vehicle has moved a sufficient distance away from the lane marker. There is a warning lamp on dash panel. If the warning lamp is lit green, the system is active and "on alert". The system can be deactivated by the driver.

Figure 2 - LDWS information on dash panel of Audi A4 lane assist and ACC

Lane Change Assistance System In addition to the audible signal, actually steps in and helps steer the car back on course. This steering capability is relatively limited. The aim is not to take over the steering. Instead, the maneuver is usually sufficient to help the driver take action to keep the vehicle within the current lane. These system are provided on the market e.g. by Continental and Bosch.

Blind spot detection warns the driver about cars that are approaching from the rear or cars that the driver is currently overtaking. The system uses a camera in each rearview mirror and these cameras are pointed at the so called Blind Spot, meaning the area alongside of the car which is hard to monitor by the outside mirrors.

Figure 3 - A camera is mounted under the outside mirror

When another vehicle enters the monitored zone, a lamp comes on in the relevant mirror. The driver gets a clear indication that there is another vehicle in the risk zone and can keep away. The system provides information about cars approaching from the rear and also vehicles in front that the driver is currently overtaking. This information gives the driver added scope for taking the right decision in such situations. Both sides are monitored in the same way. The system is designed to alert the driver to vehicles that are moving a maximum of 20 km/h slower and a maximum of 70 km/h faster than the driver's own vehicle. This system can now be found in cars such as the new Volvo S80, XC90 and V70.

2.2 Pedestrian Safety Systems

Pedestrian Detection System[1] support drivers to recognize a person near or on the road. These system have to work in all whether conditions and at night. Also they must be powerful enough to distinguish pedestrians from other objects near the road.
An example is BMW Pedestrian Warning system. It works during the day uses a standard camera but will also apply brakes in case of an emergency, to avoid collisions.

[1] http://www.pedestrian-detection.com/

The system can be disabled manually. Once inside the Intelligent Safety menu, if the system is active, the driver sees a check mark next to its icon. A camera feed on car's navigation screen is activated pressing a button located under the lights switch, to the left of the steering wheel. If a pedestrian enter in the car's path, drivers receive an audible and visual acute warning in the instrument cluster.

Figure 4 - Pedestrian detection warning in the instrument cluster

Similar systems are present in Mercedes S class (Night view assist plus, for pedestrian and large animals detection) and in new Volvo new Volvo V40, S60, V60, XC60, V70, XC70 and S80 (including cyclist spotting technology[2]). A system called Night Vision can be also found in cars like BMW, and Cadillac. Thanks to an infrared camera, mounted in the front of the car, the driver can when driving in the dark, discover a human being or an animal up to 300 meters away.

2.3 Forward/Rearward looking system (distant range)

Forward/Rearward looking system include a wide range of DAS; i.e. Collision Warning System, Low Speed Collision Avoidance System, Pre Safe System, Collision Avoidance System, Emergency Braking ahead, Electronic Emergency Brake Light, Intelligent Intersection (Emergency Vehicle Detection), Rear Approaching Vehicle, End-Of-Tail-Congestion Warning. In this paragraph the most widespread HMI solutions for these systems are presented.

Collision warning and avoidance is a set of direct supports to the driver to assist safer driving. It covers two distinct sets of applications:

[2] http://www.engadget.com/2013/03/06/volvo-cyclsist-detection-automatic-breaking-system/

- Collision warning, which provides information to the driver, but it remains up to the driver whether to use that information and what action to take.
- Collision avoidance, which triggers an avoidance response (e.g. deceleration) when a potential collision is detected. To date, collision avoidance remains in the developmental stage for general vehicles, and for freight and public transport vehicles. There are rare cases where it is currently used in bus services (e.g. detection of obstacle on guided busway), but otherwise it is a technology not yet in deployment in the sector. It is not considered further in this toolkit.

The following table illustrate some examples of the main options on the market in relation to frontal collision HMI solutions.

Table 2 Examples of HMI solutions on the market for collision warning

Brand	Control	Hard Control Location
BMW	Push Button	Left side stack
GM	Push Button	Steering Wheel (Left Spoke)
Honda	Push Button	LSS
Jaguar	Push Button	LSS
Nissan/Infiniti	Push Button	LSS
Toyota/Lexus	Push Button	LSS

Settings of collision warning can be usually customised or the system can be disenabled. An example is Opel forward collision alert.

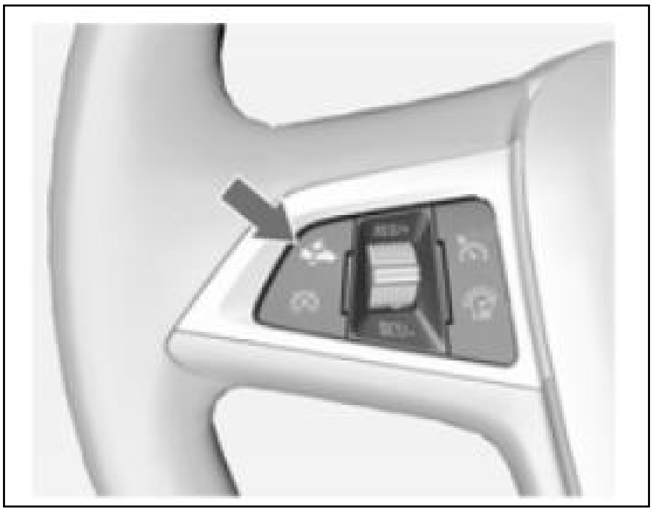

Figure 5 - Opel Collision Warning Settings

If the car approaches an obstacle (stationary or moving) and the driver does not react, a warning light activates and is reflected in the windscreen. At the same time, an audible buzzer sounds and a brake function is automatically activated to build up higher braking pressure. In certain situations, this is sufficient to catch the driver's attention and avoid the hazard. Some cars also tightens the seat belts, adjusts seat positions including rear seats (if installed) and can also close any open windows and the sunroof if necessary.

Finally, where available, emergency braking intervenes automatically (e.g. Audi braking guard, Honda: Collision Mitigation Brake System). In addition to warning the driver to take action, the brake system can be readied to provide maximum brake boost once the driver does engage the brakes enabling reduced stopping distances. When the driver brakes, the system monitors the pedal pressure. If the pressure is too light for the car to be able to stop in time, the system steps in and amplifies more braking power.

In case of Rear Pre Crash Safety System a millimeter-wave radar device in the rear bumper detects a vehicle approaching from behind. If the system determines a high possibility of collision, the hazard lights flash to warn the driver of the rear vehicle. And if the system determines a further increase in the possibility of a collision, it automatically activates the front-seat Pre-Crash Intelligent Headrests, which shift to appropriate positions prior to impact to reduce the risk of whiplash injury.

2.4 Adaptive Light Control

This set of DAS includes at the moment Adaptive High Beam Assist, Partial High Beam Assist, Inter Urban Light Assist, Map supported Frontal Lighting. LightBeam Controller is used to assist drivers in controlling vehicle's beams increasing its correct use, since normally drivers do not switch between high beams and low beams or vice versa when needed.
The adaptive light controller manages the swiveling modules so that they always deliver the perfect light for urban, interurban and highway driving.

In the AUDI adaptive light system a video camera mounted in front of the inside mirror recognizes preceding and approaching vehicles by their lights. A computer adapts the vehicle's own light through a smooth range that always provides the maximum possible illumination.

In the AUDI solution the headlight control is connected with the navigation system, which reads the route data in advance and relays them to the light computer, so as to activate the longer-range highway lighting while still on the on-ramp to the highway, for example. The system automatically switches on the cornering light before entering an intersection. The high-beam assistant, which uses a small camera in the rearview mirror, is available in many Audi models. It detects oncoming vehicles and towns based on their illumination and switches automatically between the high and low beams.

From the HMI point of view the driver can control the function of the adaptive light in the Audi drive select display placed in the instrument cluster.

2.5 Park Assistant

Intelligent Parking Assist System (IPAS), assists drivers in parking their vehicle. Via an in-dash screen and button controls, the car can steer itself into a parking space with little input from the user. The first solution on the market has been introduced by Toyota. In the Toyota Lexus system the driver is responsible for checking to see if the representative box on the screen correctly identifies the parking space; if the space is large enough to park, the box will be green in color; if the box is incorrectly placed, or lined in red, using the arrow buttons moves the box until it turns green Once the parking space is correctly identified, the driver presses OK and take his/her hands off the steering wheel, while keeping the foot on the brake pedal.

Shifting to reverse parking automatically activates the backup camera system, and the driver selects the reverse park guidance button on the navigation/camera touchscreen (the grid appears with green or red lines, a flag symbol representing the corner of the parking spot, and adjustment arrows; reverse parking adds rotation selection).

The system is set up so that at any time the steering wheel is touched or the brake firmly pressed, the automatic parking will disengage. The vehicle also cannot exceed a set speed, or the system will deactivate. The driver can then shift to drive and make adjustments in the space if necessary. Usually the driver can customise the display mode and the volume and frequency of the acoustic signal in the in-dash screen. A Blinking LED on button + continuous beeping indicates a system failure. The following figure illustrates Lexus system.

Figure 6 - Lexus backup camera system showing the parallel park setup screen

2.6 Night vision system

Information on Night Vision System partially overlap with paragraph 2.2 on pedestrian detection.

Everything that generates heat such as a person, an animal and to some extent trees and bushes can easily be monitored on the display. Night Vision makes it possible for the driver to discover an object much sooner. When driving at the speed of 100 km/h, the driver can discover a person up to five seconds before he or she is light up by the cars headlight. The extra five seconds helps the driver to increase the safety margins and decrease the stress. The image section also follows the road even in curves and objects far away can be enlarged. Night vision can be executed in different forms, such as infrared headlamps or thermal imaging cameras. Most widespread solution is infrared.

As mentioned in 2..2, If a pedestrian during night enter in the car's path, drivers receive an audible and visual acute warning in the instrument cluster (e.g. in BMW and Mercedes systems) and, if danger is imminent, sounds an alarm and pre-charges the car's brakes.

Different solutions in relation to HMI of night vision system have encompassed for instance head-up displays[3]. An example is the System introduced on Toyota Lexus LS600[4]. Instead of a traditional display screen in the instruments cluster, the Night Vision picture is directly projected on the windscreen. This results in less head movements for the driver and thus gives less distraction (Korzeniewski, Jeremy). A possible problem in the future may be with camera assisted night vision that informs the driver of what is coming up on the road. If the driver concentrates too much on the display with night vision, he might miss things on the road not displayed. Still it's more common that these problems appear while using other, not driver related systems (e.g. mobile phones).

Figure 7 - Night vision head up display System introduced on Toyota Lexus LS600

2.7 Cruise Control System

Adaptive Cruise Control, maintains the desired speed chosen by driver, but also monitors and controls the distance to the vehicle ahead of the car on the motorway or a country road. As soon as another vehicle ahead is within a certain distance and driving at a lower speed, long range radar, mounted in the front, detects the situation and ACC adjusts the distance by braking the car the exact amount that's needed

3 https://www.isuppli.com/Automotive-Infotainment-and-Telematics/News/Pages/Automotive-Head-Up-Display-Market-Goes-into-High-Gear.aspx

4 http://en.wikipedia.org/wiki/Automotive_night_vision

When activated, ACC give gas and slightly applies the brake in a way to keep as high comfort as possible. The amount of power applied on the brakes is limited to a comfortable level that corresponds to a car deceleration of 2 m/sec2. The driver can however take over the control at any time or apply the brakes himself. And this is indeed necessary whenever the system reaches its limits, since it is for most car manufacturer's philosophy to maintain the driver's responsibility in and for his car. If a situation occurs that needs the system to apply the brakes the maximum amount, the driver is informed accordingly by a light and sound. To activate ACC the driver first chooses his "personal" speed in 10 km/h intervals (see figure).

Figure 8 – ACC light in the speedometer when approaching a slower car

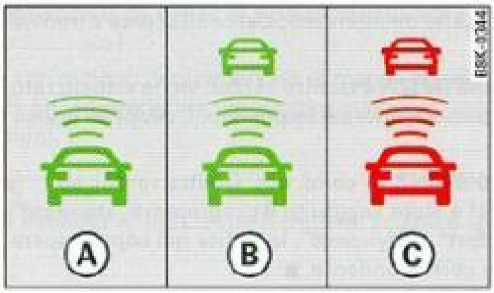

Figure 9 – Example of Audi ACC warning light in the display

Adaptive Cruise Control with Stop & Go

In traffic jam situations the car follows the impeding vehicle until this comes to a standstill. To drive off afterwards the driver has to take action (e. g. press a button). Stop & Go means that also drive off is done automatically. For safety reasons additional sensors are required.

2.8 Traffic sign and traffic light recognition

Traffic Sign recognition systems enable the vehicle to recognise the traffic signs put on the road e.g. "speed limit" or "children" or "turn ahead" and the traffic light. The technology is being developed by many automotive suppliers, including Continental and Delphi. Second generation systems can also detect overtaking restrictions. It was introduced in 2008 in the Opel Insignia. This technology is also available on the Volkswagen Phaeton and since 2012 in several Volvo models as a technology called Road Sign Information.
As for traffic light recognition, Toyota has recently undertaken a large scale test of this DAS in Japan[5]. The system transmits traffic light information to vehicles, providing alerts to vehicle occupants via the audio system and on-screen on the navigation system. Similar drivers' warning solutions applies to traffic sign detection. For instance the BMW traffic sign recognition system[6] depicts overtaking ban or speed limit on the instrument panel in the form of a traffic sign until the restrictions is changed or lifted. In the Mercedes S class 2014 solution a visual and acoustic warning is additionally output in the instrument cluster[7].

2.9 Navigation Map supported Systems

Navigation Map supported Systems include for instance Curve Warning System and Fuel Economy System.
Curve Speed Warning System is designed to prevent drivers from entering a curve at a speed faster than the speed allowed at the upcoming part of the route. Integration with navigation maps allow predictive ability of the system in relation to road curvature data. Whenever the driver exceeds this critical speed, a warning is emitted (S. Glaser, L. Nouveliere, and B. Lusetti). In case of fuel economy system, Road slope, traffic sign and signal location derived from the digital map enable predictive energy used. Driver information is provided through the Navigation screen. In such systems drivers have also the option to choose e.g. fastest route or eco-route, and can monitor and track their vehicle's real-time fuel economy. An example is MyFord Touch™ system, presented in the following figure.

[5] http://www.globalfleet.com/toyota_to_test_traffic_light_recognition_system_53986-en-517-184305.html
[6] http://www.bmw.com/com/en/newvehicles/1series/3door/2012/showroom/safety/traffic_sign_recognition.html#t=l
[7] http://www.digitaltrends.com/cars/mercedes-benz-introduces-wrong-way-warning-system/

Figure 10 – MyFord Touch™ fuel economy system

2.10 Vehicle interior observation

This set of DAS includes Driver impairment warning System (drowsiness, fatigue, ...), Driver/Rider visual Distraction Warning System (focus on the driving task, eye gaze evaluation), Occupant Detection and Classification System.

Driver alert systems are specifically aimed at identifying signs of driver fatigue. Rather than triggering only when a vehicle is in danger of straying from its lane, these systems look for the sort of erratic movement typically associated with an impaired driver. Other systems take it a step further by monitoring the driver's eyes and face for signs of drowsiness. Each OEM that offers a driver alert system has its own take on the technology, but the most common configuration uses a front-facing video camera that is mounted so that it can track both the left and right hand lane markings. Some of these systems can also function if only one lane marking is visible. By tracking the lane markings, or examining other inputs, the driver alert system can detect signs of fatigued driving. Some driver alert systems use complex algorithms to differentiate between intentional movements and the sort of drifting and jerky steering typically associated with a fatigued driver. Other systems have sensitivity controls that the driver can adjust, and most can be switched of manually.

In addition to monitoring the way that a car is being driven, some driver alert systems can also monitor the driver by looking for signs of drooping eyelids, slackened facial muscles, or other tell-tale signs of drowsiness. These features aren't as widely available, though a number of OEMs are working with advanced facial recognition technology for future implementations of their driver alert systems.

When a driver alert system detects signs of driver fatigue or drowsiness, a number of things can happen. Some of these systems provide a multi-tiered method, which increases in severity as time passes. These systems will typically start off by sounding some type of buzzer or chime and illuminating a light on the dash. If the driver stops driving erratically at that point, the system will typically shut off the nag light and reset itself. However, if the signs of fatigued driving continue, the driver alert system may sound a louder alarm that requires some sort of driver interaction to cancel. Some driver alert systems eventually progress to an alarm that can only be cancelled by pulling the vehicle over and either opening the driver's door or shutting the engine off. Some of the OEMs that offer some type of driver alert system include: Ford Driver Alert, Mercedes-Benz Attention Assist, Toyota Driver Monitoring System, Volkswagen Fatigue Detection System, Volvo Driver Alert Control presented in the following figure.

Figure 11 - Volvo Driver Alert Control warning message in the dashboard display

3. TOWARDS THE DESERVE HMI SOLUTION: DESIGN GUIDELINES

The aim of this chapter is to present some design guidelines which will support the elaboration of the DESERVE HMI solution, taking into account literature on HMI for ADAS and the state of the art analysis presented above. The final HMI solution will be presented in D34.1. The guidelines elaborated are presented below.

Any Human machine interface which is used while driving have to meet high standards. This is due to the fact that the potential to distract the driver and in this way to trigger an accident is great (A. Schmidt, A. Dey, A. Kun, and W. Spiessl). Humans have a working memory which limits the number of simultaneous tasks that can be performed. The tasks also compete for the attention from the driver. This is a typical cause to accidents when we talk about in car phones or in car entertainment such as music players. However it can be a cause to problems even if the system that brings the information was originally meant to prevent accidents. For instance one of the outcome of EuroFOT project is that user acceptance of some DAS is generally high but in some cases drivers also experienced a higher workload and, despite rating the system as “quite easy to use”, found the acoustic warning quite annoying (EuroFOT consortium). For that reason, it must be guaranteed that the driver is focused on the road and not on the onboard interaction with the system. Therefore, when presenting information or warning, the main focus should be on not distracting or annoying the driver. This is why a lot of research in this field is dedicated to the impact on driving performance of e.g. on voice and/or visual interaction devices (e.g. on-board aftermarket devices in case of the TELEFOT IP project, FP7).

Fewer touches, fewer screens and higher user satisfaction

Proliferation of ADAS have corresponded to a multiplication of on board information and warning messages. One of the main requirements of the DESERVE platform from the HMI point of view will be handle in an integrated way the increasing number of DAS functions so to prioritize them and streamlining the interface. DESERVE will actually unify Human Machine Interface of ADAS functions in order to implement an integrated, safe and harmonized interaction with the driver.

In this respect one of the currently most popular architecture for human-machine interfaces is the so-called adaptive Human Machine Interface (see Amditis Angelos, Katia Pagle, Gustav Markkula, Luisa Andreone, 2011).

Its task is to assist the user in such a way that the most salient information has to be provided in the most appropriate form, and at the most opportune time. The decision what piece of information is important depends on the information's relevance according to the desirable goal at the particular moment. Of course an immediate consequence is that the most relevant information should always be highlighted and timely prioritized.

Allow users customization

The driver should choose what information to be displayed depending on its preference, road type and traffic conditions. This is in line with mainstream practices and state of the art research (See for instance Sandro Rodriguez Garzon, Mark Poguntke, 2012). The DESERVE HMI solution should allow users to easily adapt information and warning messages to their needs, while maintaining high safety standards.

Consider vulnerable road users

The multiplicity of on-board systems in the market has been changing the driving task, bearing significant implication in particular for older drivers. Several studies have been conducted to report the natural functional declines of older drivers and the way they cope with additional sources of information and additional tasks in specific moments (Anabela Simões, Marta Pereira). The DESERVE HMI solution should take into account the specific needs of this growing share of drivers population.

Organize the HMI in such a way that new constraints and parameters can be added problem-free

The architecture of the DESERVE platform will be flexible and modular, to easily allow addition of new (software) components, modules and functions based on the same set of vehicle sensors, actuators and HMI. In this context DESERVE propose an efficient and suitable method to solve the along going challenges of modularization, flexibility and scalability (See Chapter 4 of Deserve D11.2 Platform needs).

Consider innovative alternatives

Interaction when the vehicle is in motion is a rich area for future research and there is no a *one size fits all* solution.

Until today most signals given to the driver have been light and sound signals. Moreover there is a high tendency for designers to utilize the familiar desktop computing paradigms. This means that the very well know hardware devices (e.g. touchscreens, buttons, etc.) and

the associated software approaches (e.g. use of menus, lists, scrolling etc.) are used. Systems like GPS require new types of information with signs and pictures on screens. Information on screens often requires focus of attention to be moved of the road.
But there are also alternatives: speech synthesizer can help the driver to keep looking at the road. Nevertheless, it should be noted that research has shown that the potential for cognitive distraction with speech interfaces might be an issue (AAA Foundation, 2013).
The head up display (HUD) is now on advance as an interface also in cars. It projects the picture with information directly on the windscreen, so that the driver doesn't have to move his eyes. The HUD can be one of the better ways to inform the driver of hazards in a future integrated active safety system. The use of simulators in the DESERVE project is expected to support the validation of innovative interfaces and interaction design concepts.

Special care should be always taken to display the required information timely
The reaction time is crucial for the outcome of the situation. If a signal is given too late it won't help the driver. Instead if it is given early some drivers will be pleased with deciding if it is reasonable and correct or not, other drivers will however find the early signal annoying, and therefore shutting the system down. The reaction time from signal to action is not only apprehending the signal but also realizing what's best to do. Some reactions don't have to be managed consciously but acquired by experience and therefore have a very short reaction time. The reaction time is strongly dependent on how used the driver is to the situation and how expected it was (Ljung Aust, M., & Engström, J.).

Build on previous work
HMI-related projects like HUMANIST[8] and AIDE provided guidelines dealing with on-board vehicles HMI design and validation(e.g. AIDE 2008). Relying on this work, as well as on the activity of the HMI working group under the eSafety Forum[9] the European Commission issued a Recommendation in 2007, an update of the European Statement of Principles on HMI (ESoP) (European Commission, 2007).
The first part of the ESoP incorporates 37 principles formulated as generic goals to be achieved by the design of a safe and user-friendly HMI of in-vehicle information and communication systems intended to be used by the driver while driving.
These principles of the ESoP are organised into 6 groups:

[8] http://www.noehumanist.org

1. Design goals (5)
2. Installation principles (6)
3. Information presentation principles (5)
4. Principles on interaction with displays and controls (9)
5. System behaviour principles (5)
6. Principles on information about the system (7)

Since then a working group on HMI of the imobilityforum[10] is currently revising these recommendations.

In 2012 NHTSA in the USA published work reviewing research on distraction and international guidelines[11]. They also proposed as voluntary guidelines a series of lock-out requirements for specific functions and verification criteria for visual-manual interfaces to limit distraction while driving.

As for standards, it is important to mention ISO 9241 - Ergonomics of Human System Interaction (ISO, 2006), and ISO 13407:1999 Human-centred design processes for interactive systems (ISO, 1999).

It is fundamental that DESERVE HMI solution build on this previous work and of course consider existing standards.

4. CONCLUSIONS

This report has presented a state of the art analysis of main HMI solutions available on the market for DAS which are relevant in the context of DESERVE and some design guidelines for the DESERVE HMI solution, taking into account existing options available on the market and literature on HMI for ADAS. These are considered a fundamental preliminary step toward the definition of the DESERVE HMI solution, in addition to the HMI needs and requirements presented in D33.1. The final HMI solution will be described and specified in D34.1, HMI solution design, relying on this work.

---

[9] http://ec.europa.eu/information_society/activities/esafety/forum/index_en.htm

[10] http://www.imobilitysupport.eu

[11] http://www.distraction.gov/

REFERENCES

[1] AAA Foundation, (2013) Measuring Cognitive Distraction in the Automobile https://www.aaafoundation.org/sites/default/files/MeasuringCognitiveDistractions.pdf

[2] AIDE - Adaptive Integrated Driver-vehicle Interface (2008). IST-1-507674-IP Recommendations for HMI Guidelines and Standards Deliverable No. D4.3.2 www.aide-eu.org

[3] Amditis Angelos, Katia Pagle, Gustav Markkula, Luisa Andreone, Towards an integrated adaptive automotive HMI for the future (2011), Pages 253-262, UAHCI'11 Proceedings of the 6th international conference on Universal access in human-computer interaction: context diversity - Volume Part III, Springer

[4] DESERVE consortium, DEvelopment platform for Safe and Efficient dRiVE, Technical Annex Part B, 31.01.2013

[5] D112 Platform needs, DESERVE

[6] D111 Application Database, DESERVE

[7] en.wikipedia.org/wiki/Automotive_night_vision

[8] ec.europa.eu/information_society/activities/esafety/forum/index_en.htm

[9] EUROFOT consortium (2012) European Large-Scale Field Operational Tests on In-Vehicle Systems 2012(FP7-ICT-2-6.2 ICT for Cooperative Systems) Deliverable 6.3 Final results: User acceptance and user-related aspects

[10] European Commission, (2007) COMMISSION RECOMMENDATION on safe and efficient in-vehicle information and communication systems: update of the European Statement of Principles on human machine interface (2007/78/EC)

[11] Glaser, S. L. Nouveliere, and B. Lusetti, “Speed Limitation Based on an Advanced Curve Warning System,” in Intelligent Vehicles Symposium, 2007 IEEE, pp. 686–691, IEEE, 2007

[12] ISO 13407:1999 Human-centred design processes for interactive systems (www.iso.org)

[13] ISO 9241 - Ergonomics of Human System Interaction 2006 (www.iso.org)

[14] Korzeniewski, Jeremy (2008-05-31). "Toyota introduces Night View on Japanese Crown Hybrid — Autoblog Green". http://green.autoblog.com/2008/05/31/toyota-introduces-night-view-on-japanese-crown-hybrid/

[15] Ljung Aust, M., & Engström, J. (2011). “A conceptual framework for requirement specification and evaluation of active safety functions”. Theoretical Issues in Ergonomics Science, 12(1), 44 – 65

[16] Rodriguez Garzon, Sandro Poguntke Mark (Daimler) The Personal Adaptive In-Car HMI: Integration of External Applications for Personalized Use, in Advances in User Modeling Pages pp 35-46, 2012, Lecture Notes in Computer Science, Springer Berlin Heidelberg

[17] Schmidt, A. A. Dey, A. Kun, and W. Spiessl, “Automotive User Interfaces: Human Computer Interaction in the Car,” in Proceedings of the 28th of the International Conference Extended Abstracts on Human Factors in Computing Systems, pp. 3177–3180, ACM, 2010.

[18] Simões, Anabela, Pereira Marta, Older Drivers and New In-Vehicle Technologies: Adaptation and Long-Term Effects Human Centered Design, Lecture Notes in Computer ScienceVolume 5619, 2009, pp 552-561

[19] TELEFOT- Field Operational Tests of Aftermarket and Nomadic Devices in Vehicles (IP, FP7) www.telefot.eu

[20] www.distraction.gov

[21] www.imobilitysupport.eu

[22] www.interactive-ip.eu

[23] www.noehumanist.org

[24] www.pedestrian-detection.com/

[25] www.engadget.com/2013/03/06/volvo-cyclsist-detection-automatic-breaking-system/

[26] www.isuppli.com/Automotive-Infotainment-and-Telematics/News/Pages/Automotive-Head-Up-Display-Market-Goes-into-High-Gear.aspx