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# Luxoft SafeHMI for Driver Monitoring and Alerting

October 19th, 2016 | Dealing with driver distraction

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# Agenda

- Driver Distraction
- Driver Monitoring
- Use Case Driver monitoring and alerting
- Logical Architecture
- SafeHMI Pedastrian alert flow sequence
- Demonstrator setup
- Video presentation of Driver monitoring and alerting UseCase



## **Driver distraction**

#### Dealing with driver distraction.

Drivers engage in a large variety of activities.



UMTR9-8005-83		nhisa	DIST	RACTIONS
THE EFFECTS OF SECONDARY TASKS ON NATURALISTIC DRIVING PERFORMANCE	The 100-Car Natu	verans		
James R. Sayer Joel M. Devoestine Carol A. Flannagan	Phase II – Results of Experiment	f the 100-Car Field		VERYDAY
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1. In 54 % of all 20000 six-second baseline epochs drivers were engaged in tasks other than driving. ⇒ People may want to make use of the steadily increasing amount of time they spend in their vehicles.

2. "Reaching for a moving object" was shown to have the highest impact on the likelihood of crash or near crash followed by "external distraction", "reading", "applying makeup", and "dialing hand-held device". ⇒ Driver distraction must be regarded as a societal problem, not as a problem of a specific industry alone.



## **Driver distraction**

#### Odds Ratio for Secondary Tasks in the 100-Car Study

Type of Secondary Task	Odds R	atio		
Reaching for a moving object	8	.82		
Insect in Vehicle		.37		
Looking at External Object		.70		
Reading	3	.38		
Applying Makeup		.13		
Dialing a Hand Held Device	2	.79		
Inserting/retrieving CD		.25		
Eating		.57		
Reaching for a Non-Moving Object		.38		
Talking/Listening to a Hand-Held Device1.29				
Drinking from an Open Container	1	.03		
Other Personal Hygiene		.70		
Adjusting the Radio	0	.50		
Passenger in the Adjacent Seat	0	.39		
Child in Rear Seat		.33		

Odds ratio indicates the likelihood of an increase in risk associated with that activity.

Example:

Driver is 3.38 times more likely to be in a crash / near-crash while reading and driving than if she/he were just driving normally.

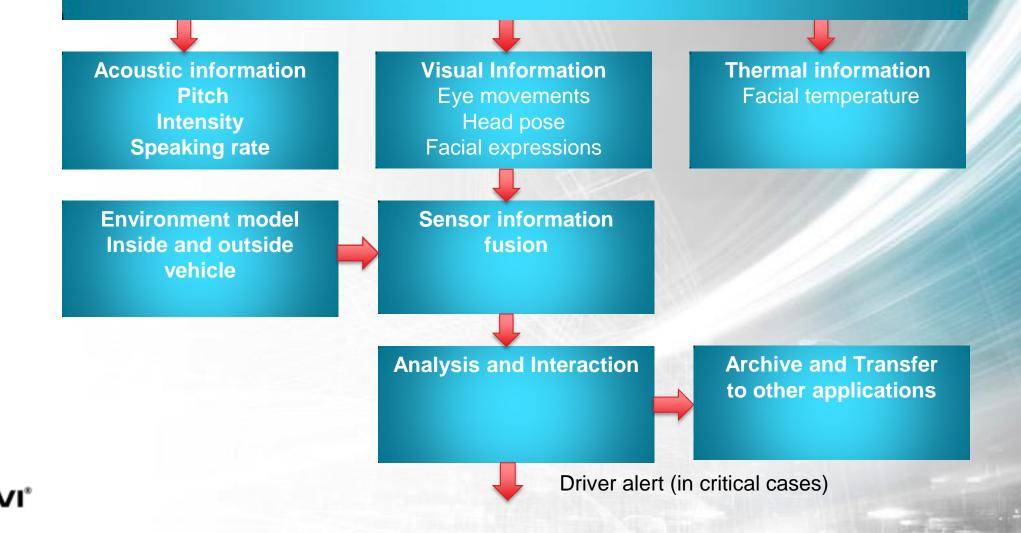


#### Goal: Detection of driver distraction situation



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Visual, acoustic and thermal sensors to observe the driver state



Eye Movements

Saccades

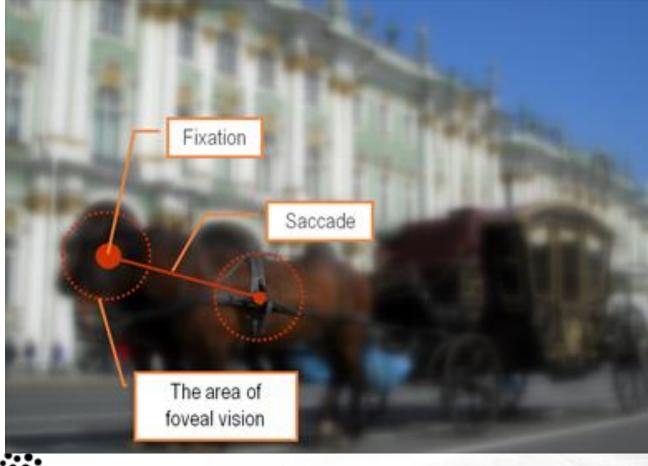
Movements of eyes that are aimed at focusing the visual attention to a different object.

Fixations

Movements of eyes which stabilize the retina on the object of interest.



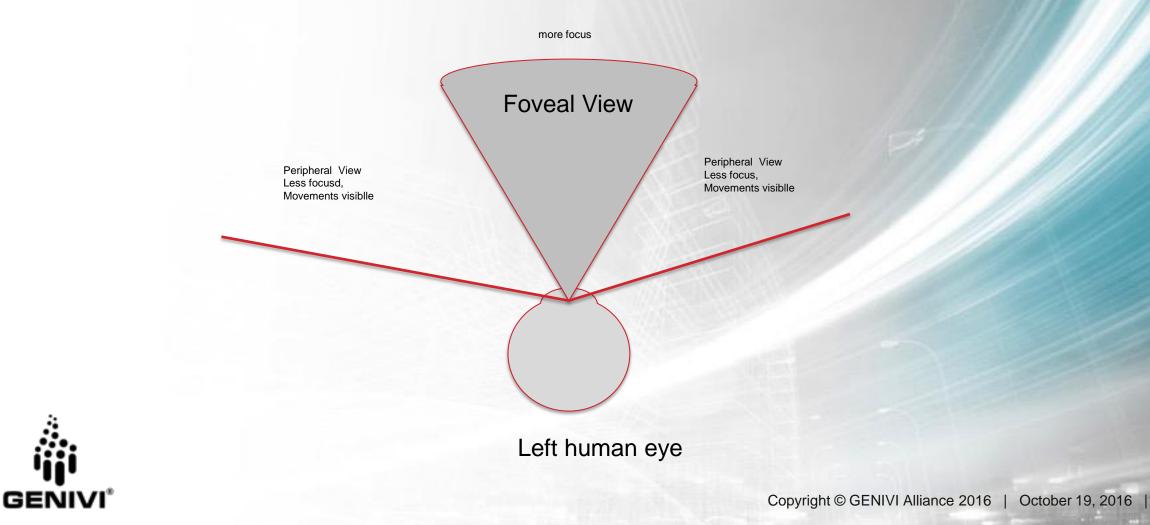
## **Driver Monitoring** Eye Movements



Stop length, when the eye fixates, varies from 100-600 ms During stops the brain processes the visual information received from the eyes. Saccades are jumps from fixation to fixation. Average length of a saccade is about 20-40 ms. During this period the eyes don't send visual information to the brain.



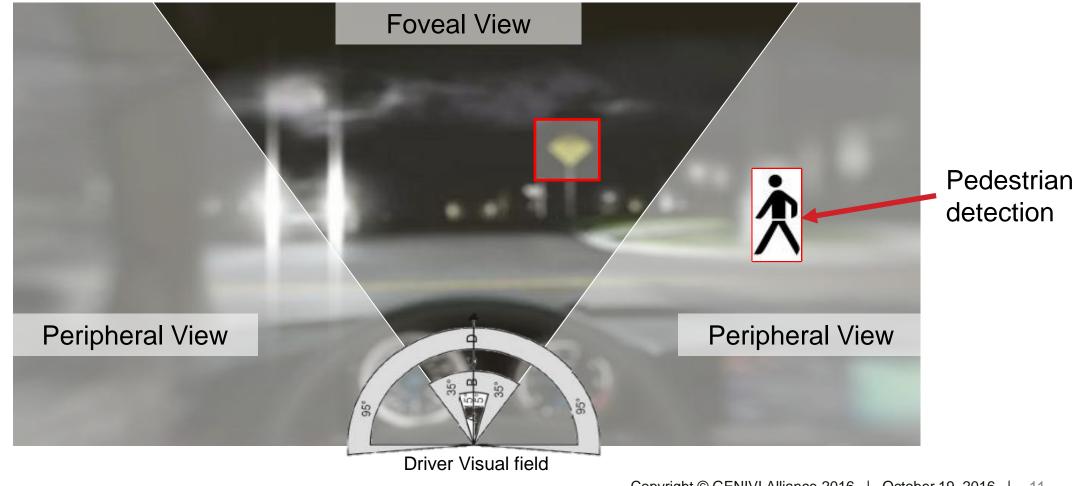
Foveal and peripheral view



# **UseCase Driver Monitoring & Alert**

Pedestrian outside foveal area detected Driver alert (Audio/Visual)

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## **Logical Architecture**

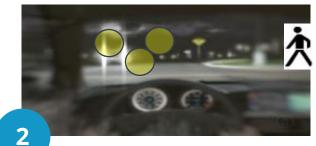
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Demo Primary Screen

Fixations can be turned On/Off Eye-tracker data SysTime Gaze point, Eye positions Fixations\_grid Fixations  $\bigcirc$ Eve-Tracker VideoIn Saccades Cal.-Cabin Camera >Screen-Eye-tracking **Coordinates Object channels** SysTime Chan0: Pedastrians Insert/delete HMI Chan1: TSR **Fusion/Update** Chan2: CARs STOP Alerts Chan3:Buildings VideoIn Chan4 Lane Detection Object\_occupancy\_grid Front View **Object Channels** Camera **Object-Detection SysTime Object detection** Chan0: Filtered Pedastrian Chan1: Filtered TSR Transform -> Chan2: Filtered CARs Screen Chan3: Filtered Buildings Coordinates ... Insert/delete time

#### SafeHMI pedastrian alert flow sequence





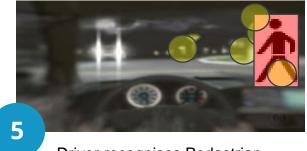
Pedatrian appears Not in foveal view



Pedatrian comes closer Still not in foveal view



Pedatrian alert is risen



Driver recognises Pedastrian







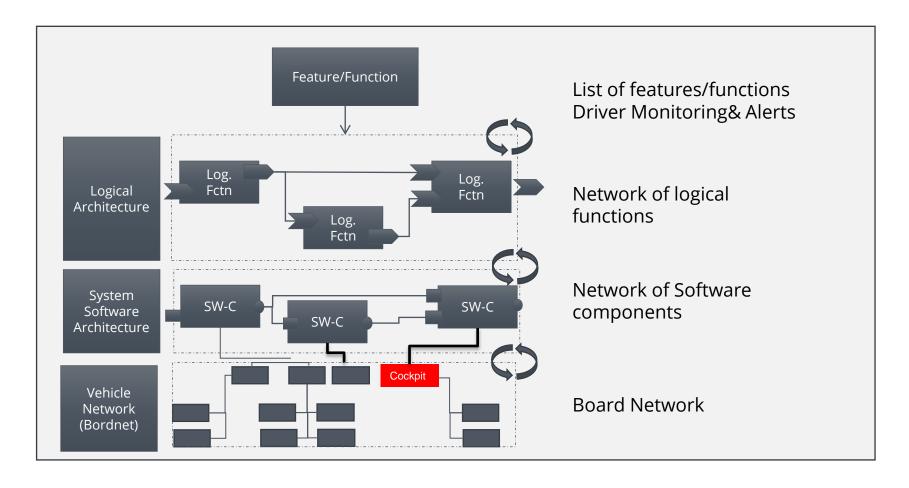
Fixation



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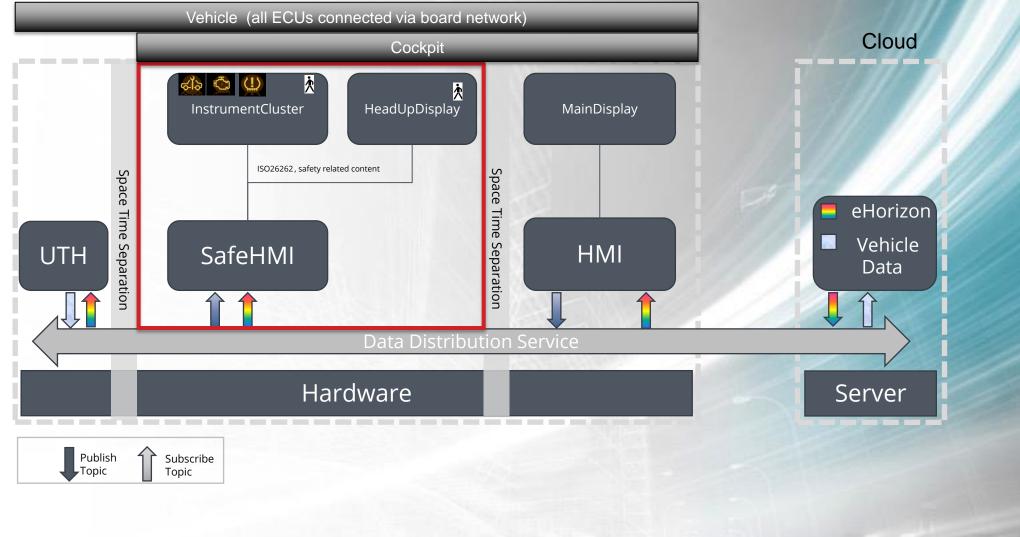
## **Next steps**

#### Vehicle Architecture modelling





#### Next steps High Level Cockpit Architecture

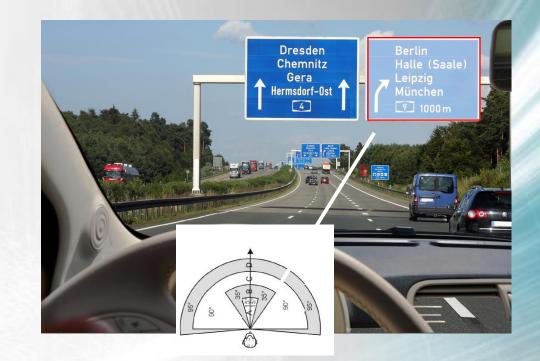




#### Next steps

Further usecases for driver behaviour monitoring

- Drives according to speed limit
  Speedsignal
- Direction prediction Route/Destination
- Safe lane change prediction
  Side view traffic







#### **Demonstrator Setup**



#### Modeling 3D City model

- add traffic signs,
- traffic lights,
- and cars according to the requirements

#### 3D cabin model

- Dashboard
- Center stack

#### Camera(s)

- In-vehicle
- Front View



#### **Demonstrator Video**





### Next steps

- Requirements capture and ASIL classification
- Define Functional Architecture
- Define HW/SW-Architecture(s)
- Step planning for integrating concept into Cockpit Architecture



This work was done in collaboration with Dr. Michael Feld

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# Thank you!

