

FIRST ADAPTATION OF A VALIDATED DROWSINESS MONITORING SYSTEM TO PROCESS FACE IMAGES INSTEAD OF EYE IMAGES

Clémentine FRANCOIS, Quentin MASSOZ, Thomas HOYOUX, Jérôme WERTZ,
Jacques G. VERLY

Dept. of Electrical Engineering and Computer Science,
University of Liège – Belgium

10th International Conference on Managing Fatigue – San Diego, CA
20 March 2017

Drowsiness: a problem of health and safety



6-11% of the population suffers from excessive daytime sleepiness

20-30% of road accidents



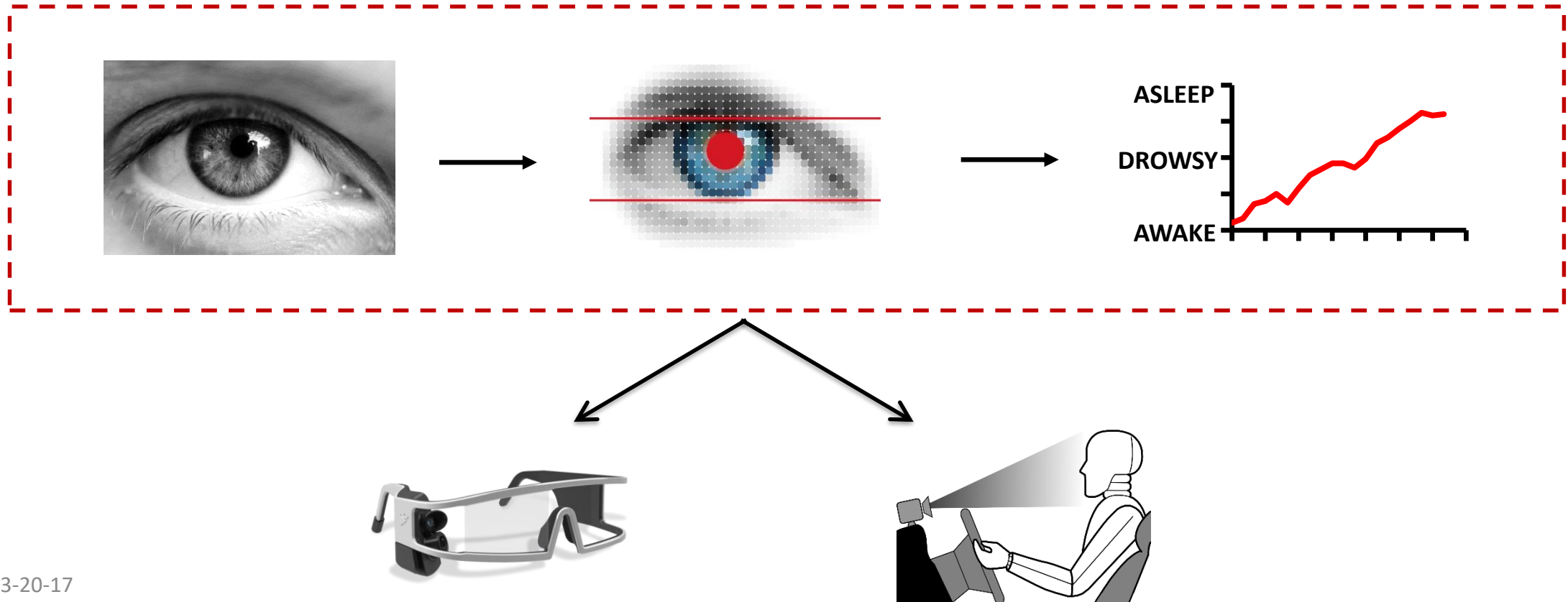
Not only transport !



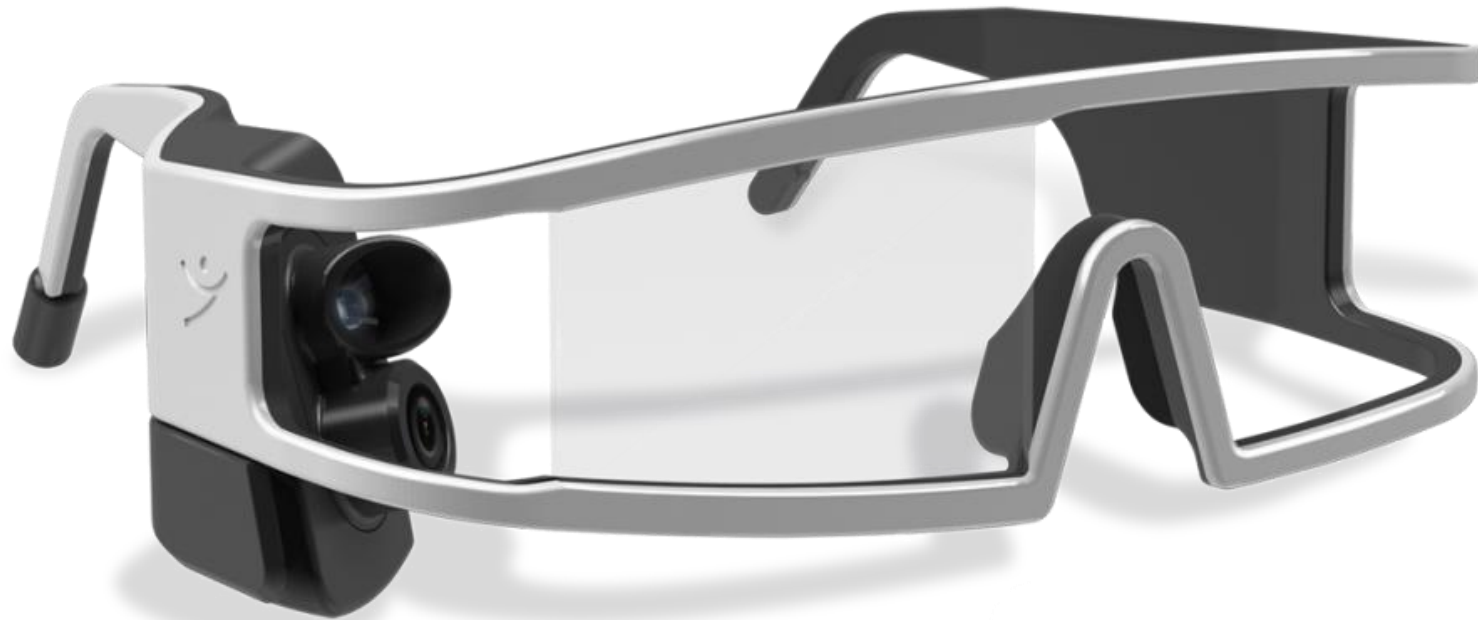
Our approach: drowsiness monitoring

An automatic and real-time drowsiness monitoring system

- based on physiological state of individuals (images of the eye)
- and producing a level of drowsiness (task independent)

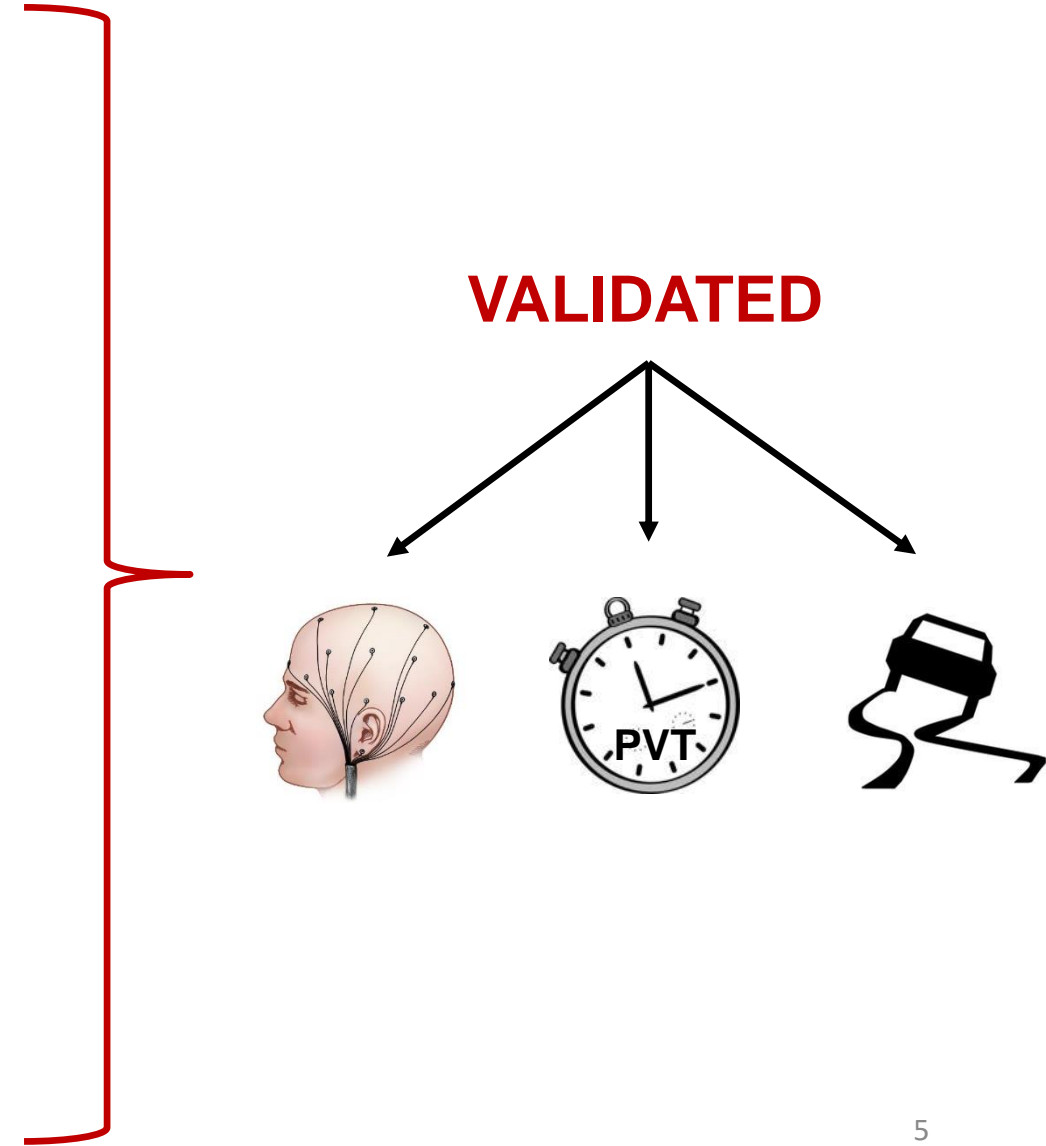
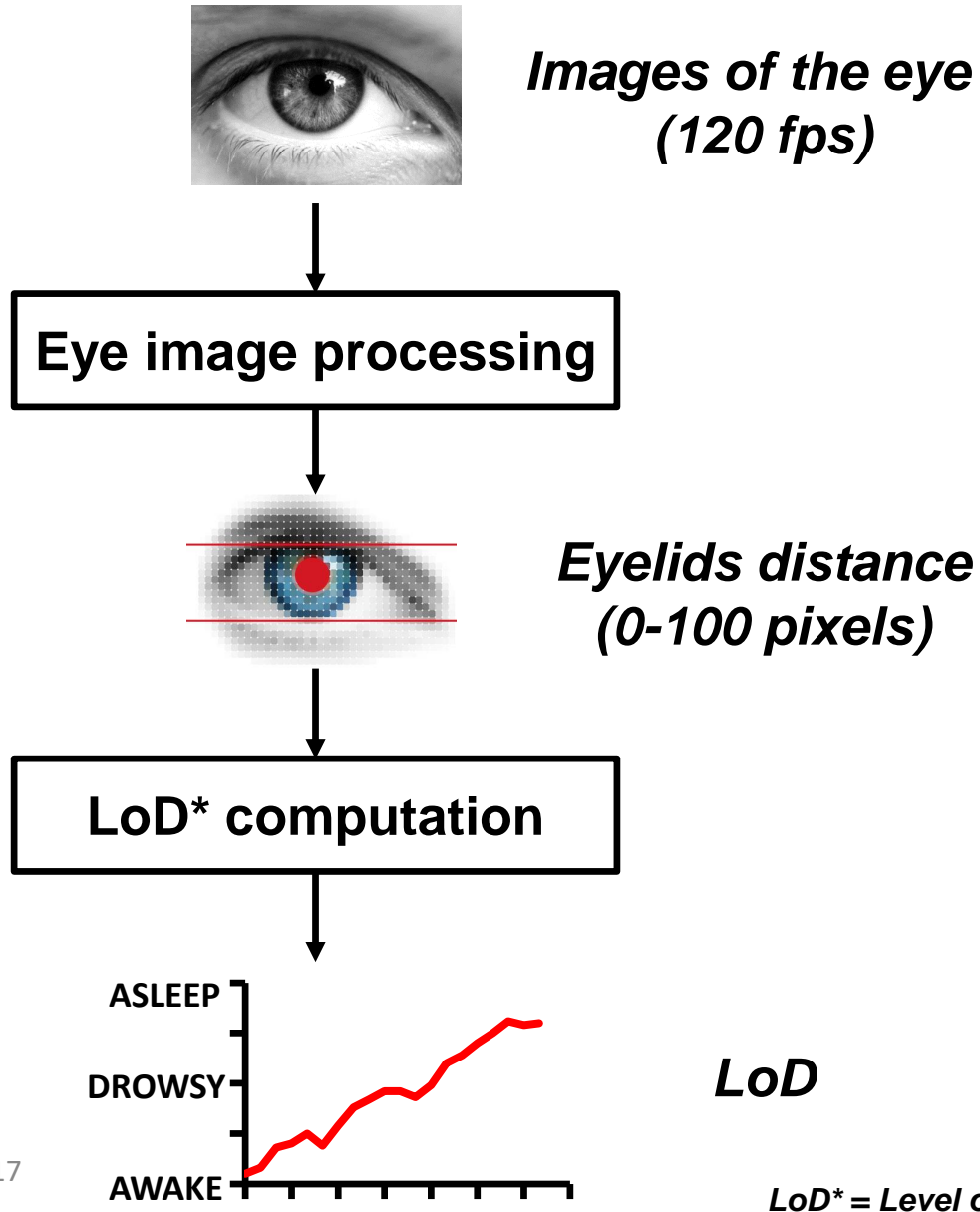


First solution: head-mounted system A

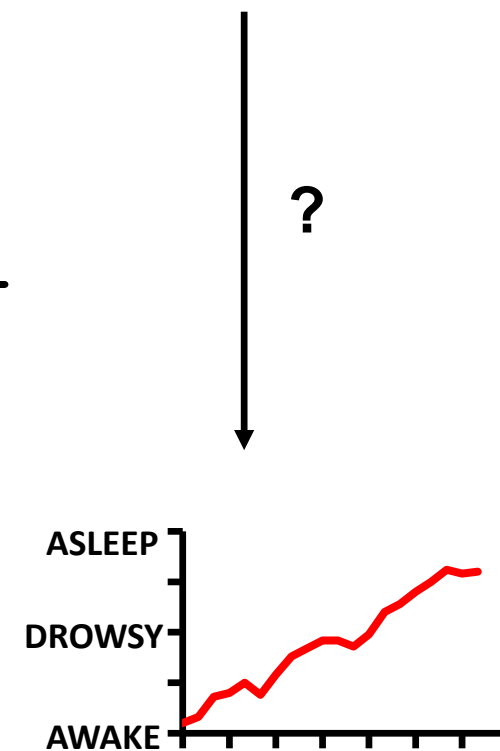
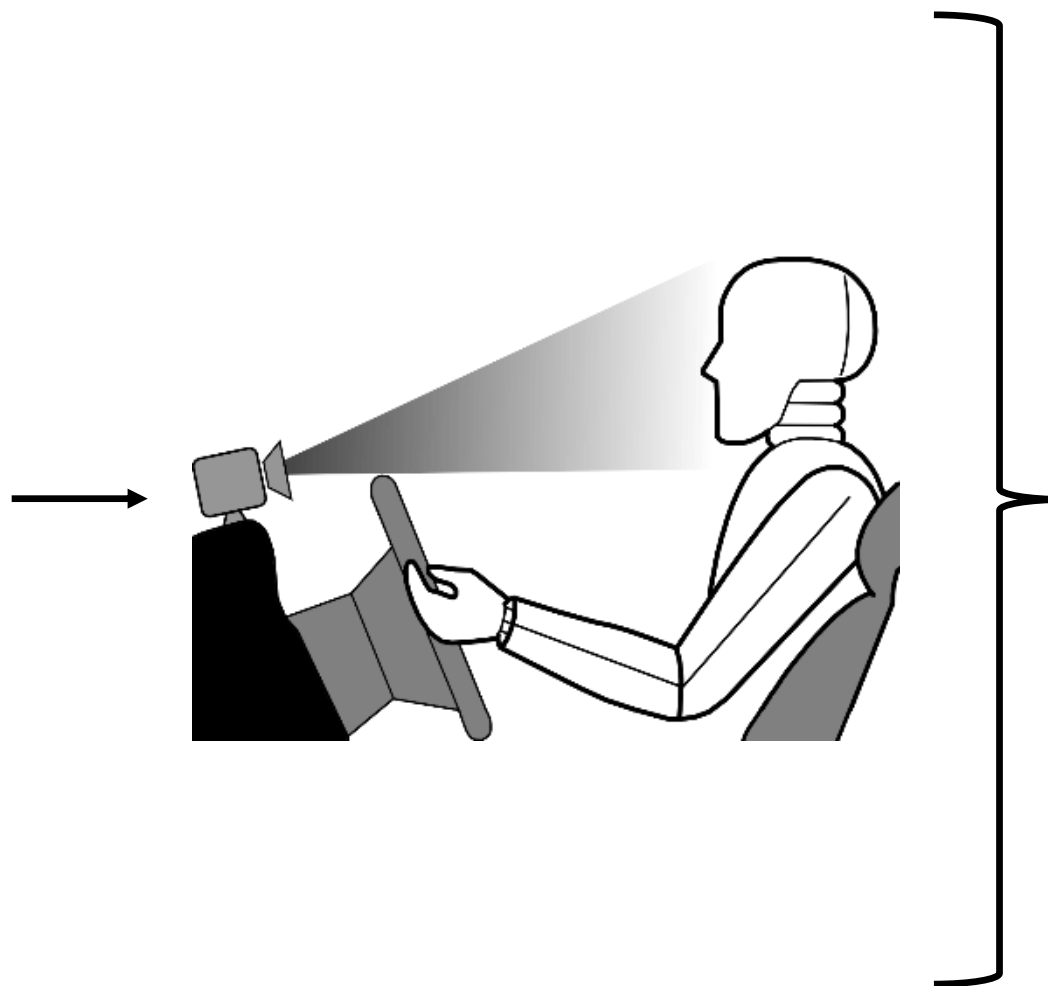


phasya
www.phasya.com

First solution: head-mounted system A



Second solution: remote system B

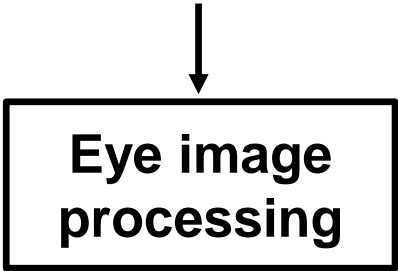


How can we do it quickly and reuse a maximum what we already have?

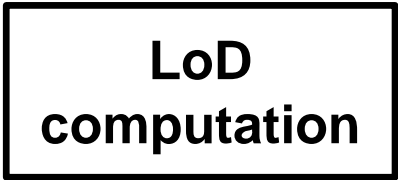
Method

SYSTEM A

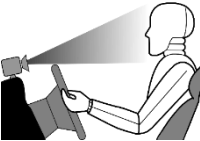
Images of the eye (120 fps)



Eyelids distance (0-100 pixels)

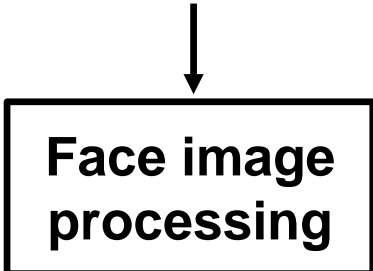


LoD

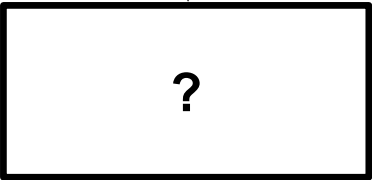


SYSTEM B

Images of the face (30 fps)



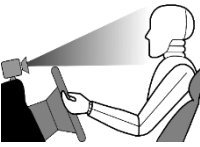
Eyelids distance (0-6 pixels)



LoD ?



Method



SYSTEM A

Images of the eye (120 fps)

Eye image processing

Eyelids distance (0-100 pixels)

LoD computation

LoD

SYSTEM B

Images of the face (30 fps)

Face image processing

Eyelids distance (0-6 pixels)

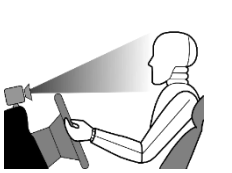
?

LoD ?

TRANSFER ?



Method



SYSTEM A

Images of the eye (120 fps)

Eye image processing

Eyelids distance (0-100 pixels)

LoD computation

LoD

SYSTEM B

Images of the face (30 fps)

Face image processing

Eyelids distance (0-6 pixels)

?

LoD ?

Adapter

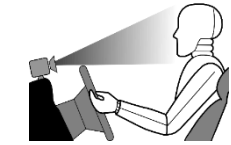
Eyelids distance (30 fps / 0-6 pixels)

Adapted LoD computation

LoD



Method



SYSTEM A

SYSTEM B

Images of the eye (120 fps)

Images of the face (30 fps)

Eye image processing

Face image processing

Eyelids distance (0-100 pixels)

Eyelids distance (0-6 pixels)

Adapter

Eyelids distance (30 fps / 0-6 pixels)

LoD computation

Adapted LoD computation

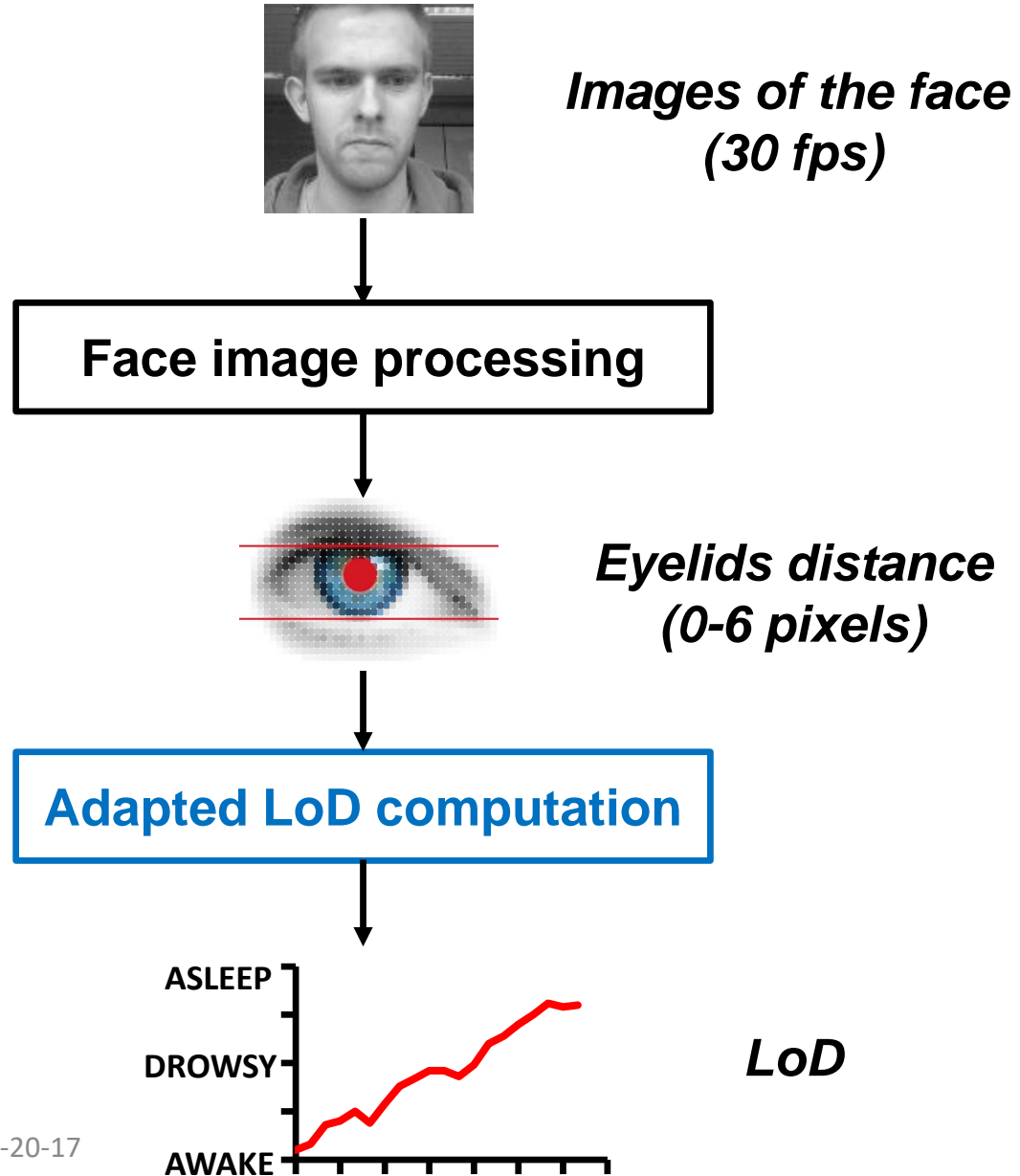
Adapted LoD computation

LoD

LoD

LoD


Our remote drowsiness monitoring system B



NEED VALIDATION


Demonstrator: video

The image shows a software interface for monitoring fatigue. It features a video feed of a woman with a green bounding box around her face. Below the video, there is a status bar with the text "Managing Fatigue 2017 - DEMO", "MONITORING" (with a redacted area), "TIME: 100", and "FPS: 47". To the right of the video feed are two line graphs. The top graph, titled "Eyelids distance", plots the distance between the eyelids over time, showing a baseline around 4.5 with several sharp drops. The bottom graph, titled "Level of drowsiness", plots the level of drowsiness (LoD) over time, showing a flat line at 1.0.

Universit  de Li ge  phasya

Collaborative work of University of Li ge and Phasya

Managing Fatigue 2017 - DEMO

MONITORING 

TIME: 100
FPS: 47

Eyelids distance

Eyelids distance

6.0
5.0
4.0
3.0
2.0
1.0
0.0

82 84 86 88 90 92 94 96 98 100

time

Level of drowsiness

Level of drowsiness

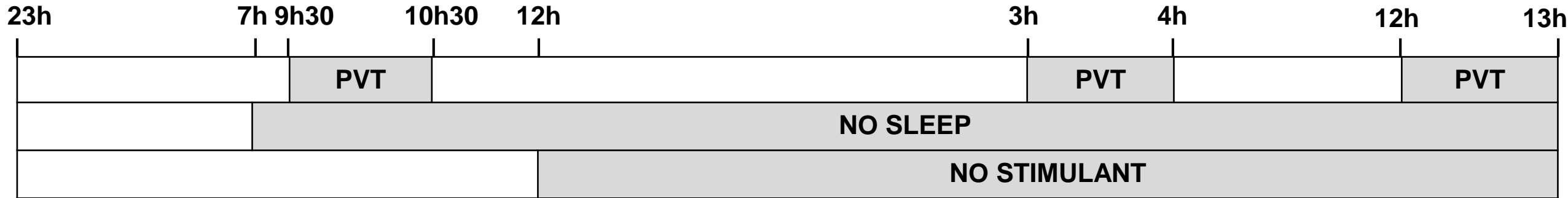
3.0
2.5
2.0
1.5
1.0

82 84 86 88 90 92 94 96 98 100

time

LoD

Data acquisition



- **35 participants (21F, 14M, mean age: 23.3 yrs, range 19-34 yrs)**
- **Task = Psychomotor Vigilance Test (duration of 10 minutes)**
- **Approval by ethics committee**
- **Data collected:**
 - **Face images**
 - **Reaction times**

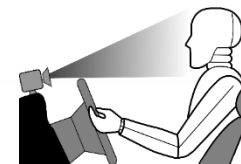
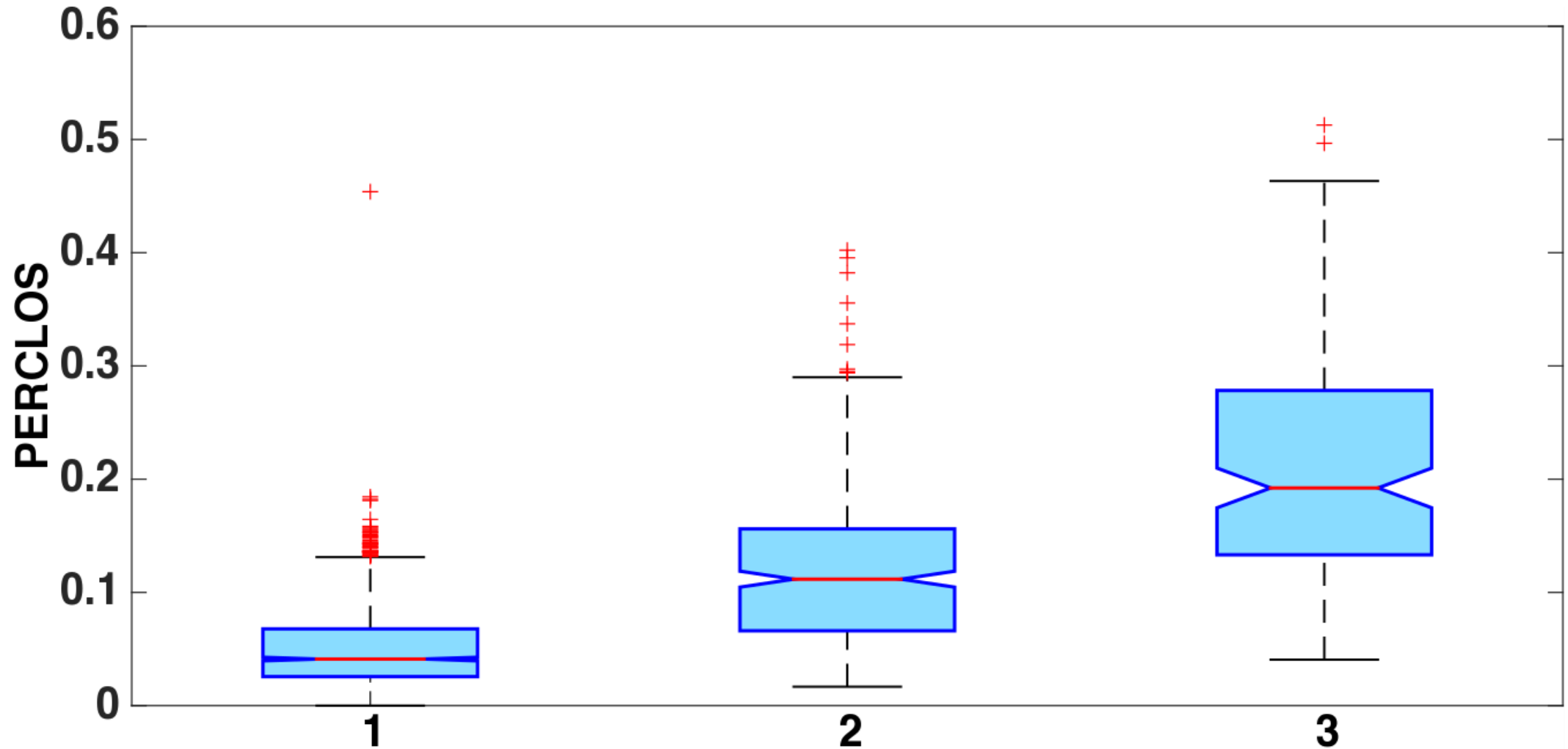


Results

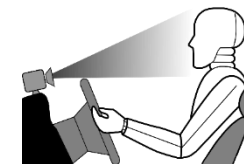
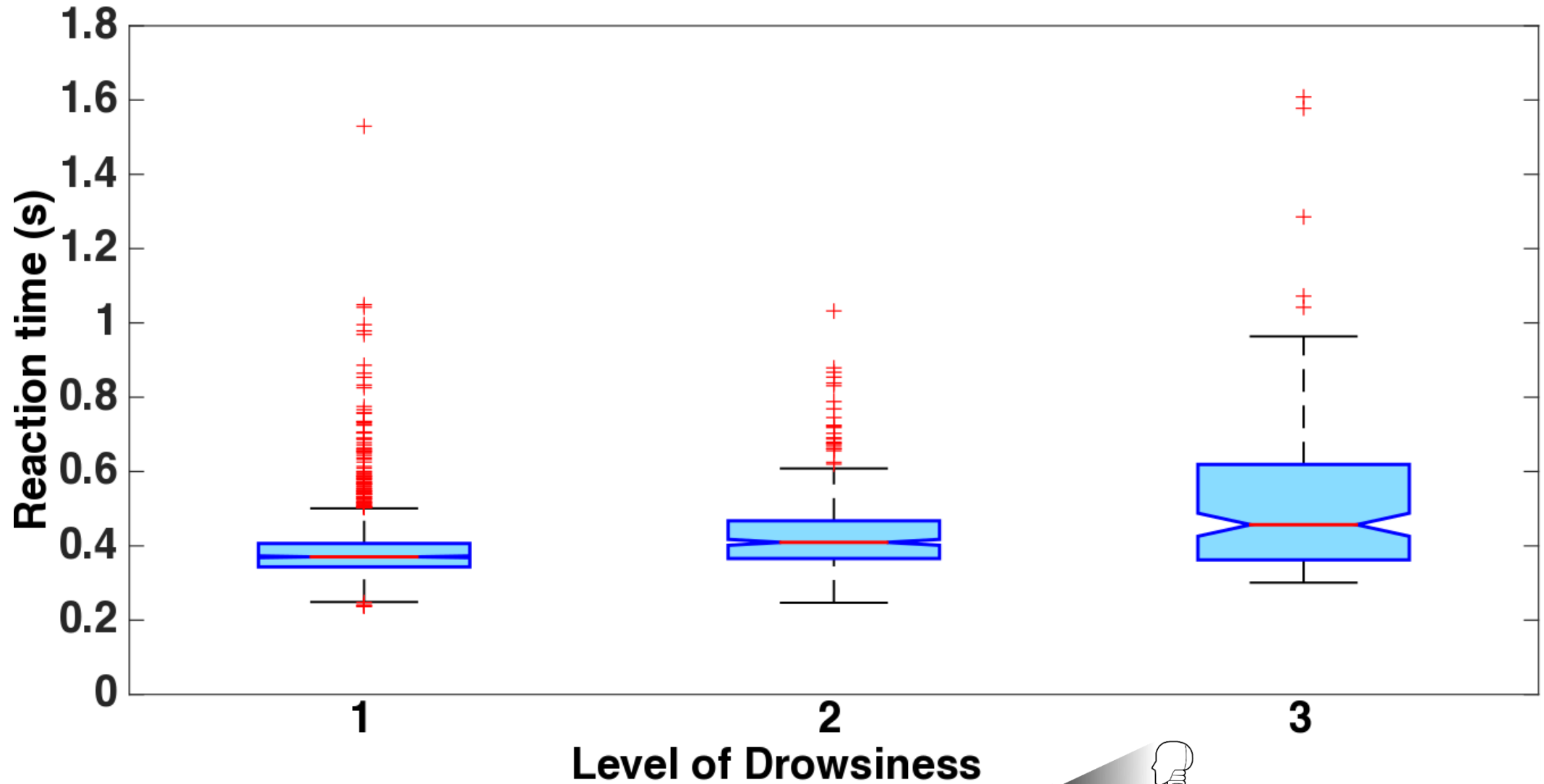
For each 1-min window of each test, we obtained:

- **LoD determined automatically by our system B**
- **The PERCLOS 70 (Percentage of eye closure)**
- **Mean reaction time (RT)**
- **Percentage of lapses (lapse = $RT > 500$ ms or no answer)**

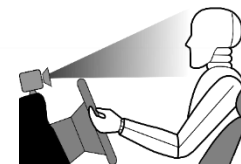
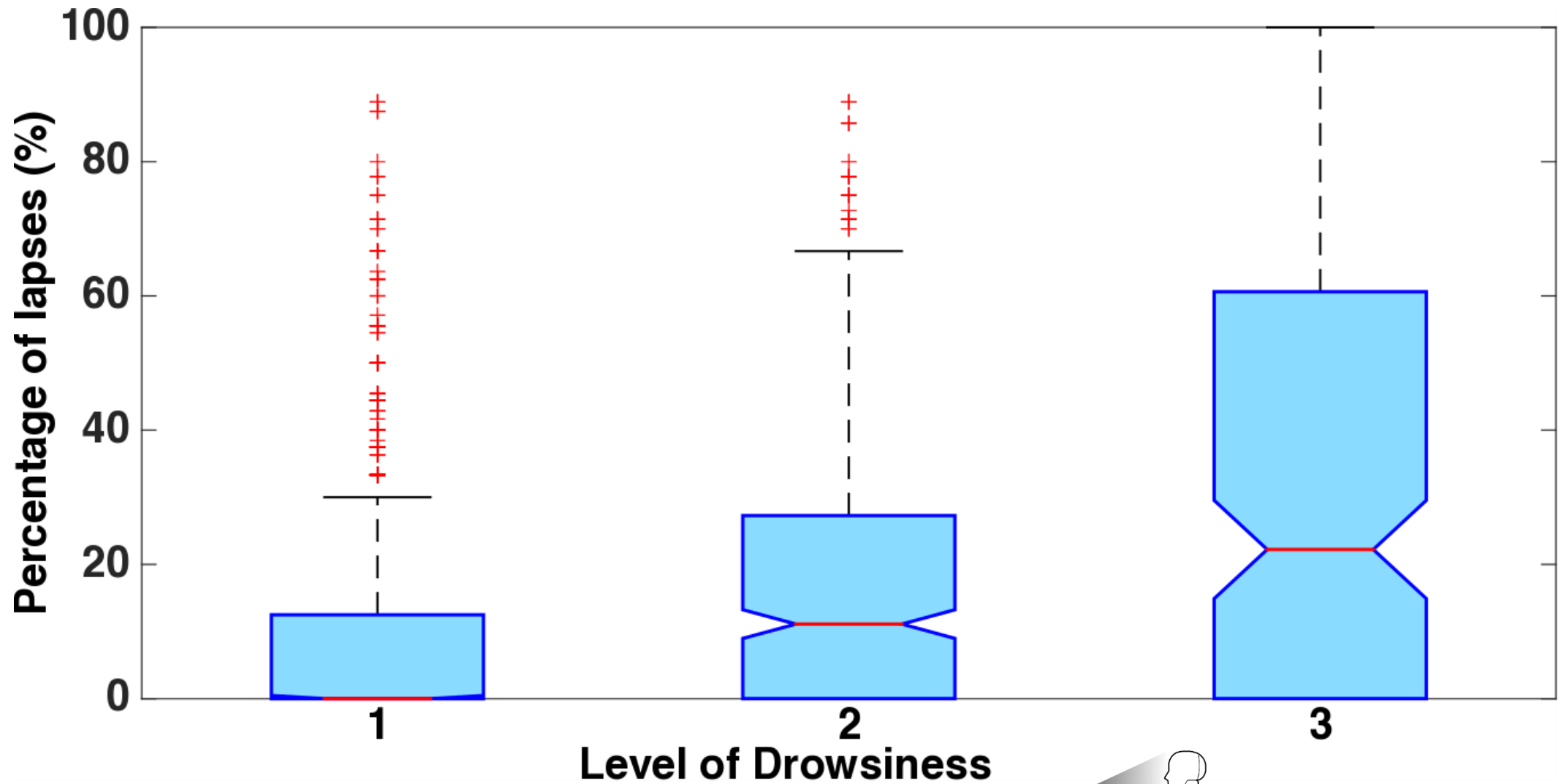
Preliminary results (1)



Preliminary results (2)



Preliminary results (3)



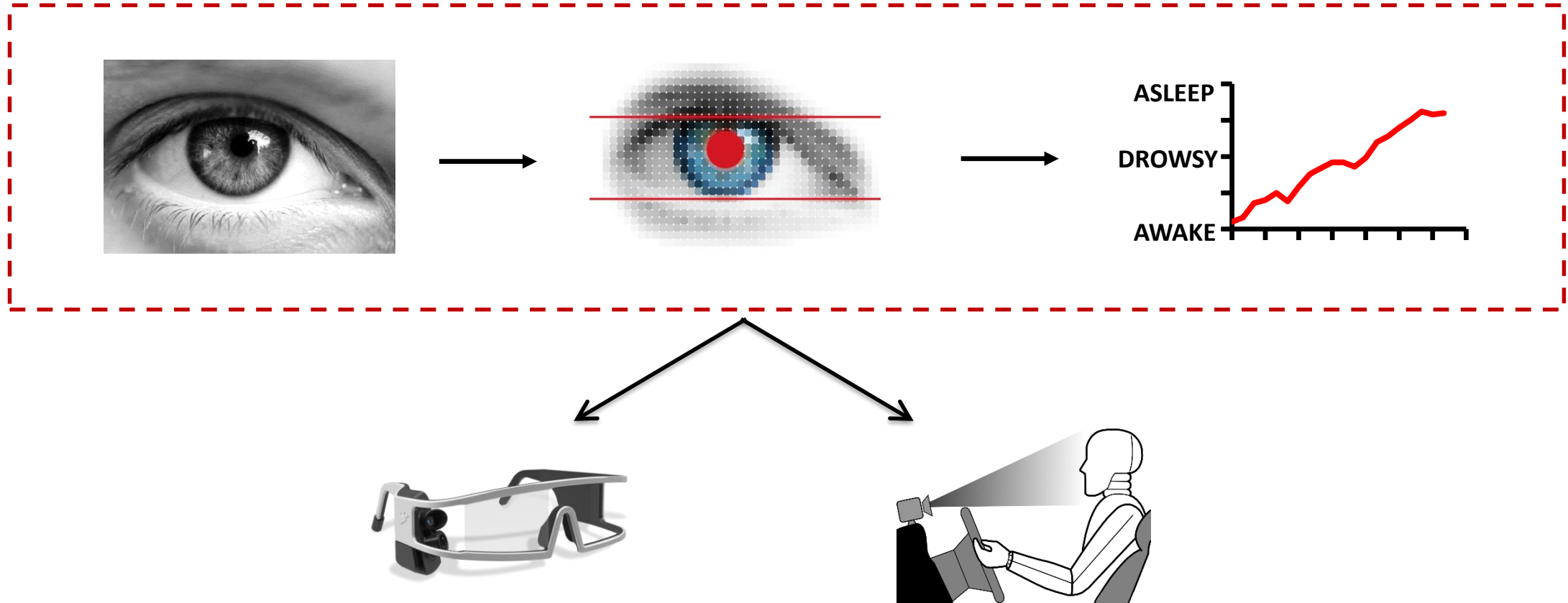
Preliminary results (4)

Mean values of PERCLOS, RT, and percentage of lapses as a function of the three LoDs.

Measures	LoD 1	LoD 2	LoD 3
<i>Mean PERCLOS + SD</i>	0.05 ± 0.03	0.12 ± 0.06	0.21 ± 0.11
<i>Mean RT (s) + SD</i>	0.386 ± 0.151	0.431 ± 0.184	0.518 ± 0.343
<i>Mean percentage of lapses (%) + SD</i>	9.30 ± 14.1	18.2 ± 21.1	31.9 ± 31.8

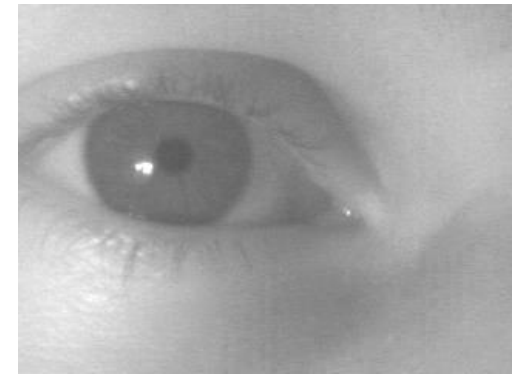
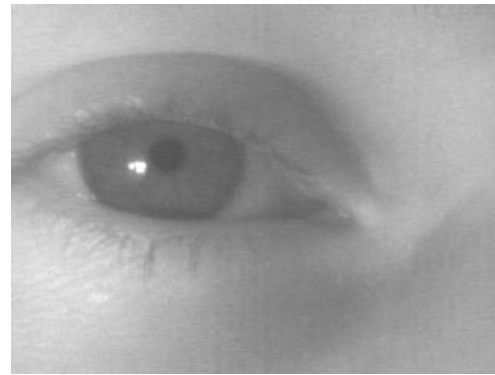
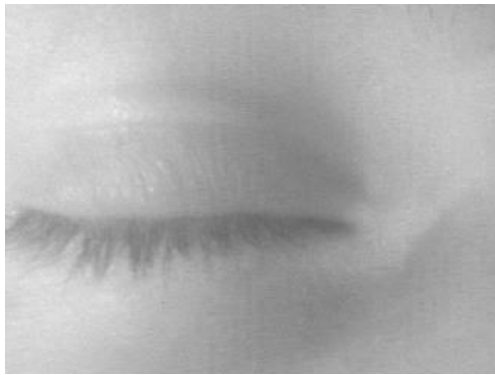
Conclusion

- Our drowsiness monitoring system can be adapted to both modalities.



- Interested in a demo → see Phasya booth.

Thank you for your attention!



Contact: cfrancois@ulg.ac.be