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

Université de Liège

Drowsiness: a problem of health and safety

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

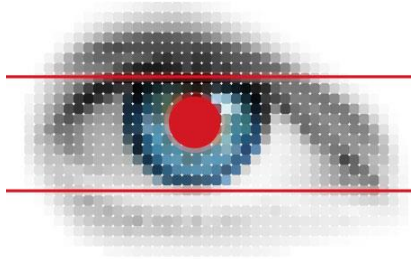
20-30% of road accidents

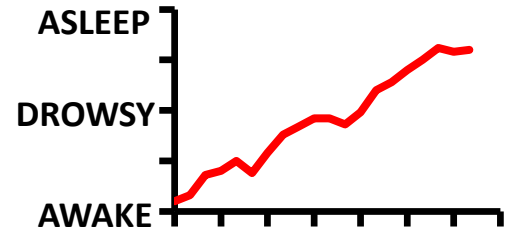
Not only transport !

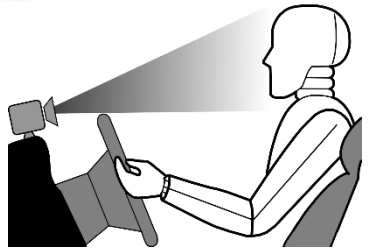
Our approach: drowsiness monitoring

An automatic and real-time drowsiness monitoring system

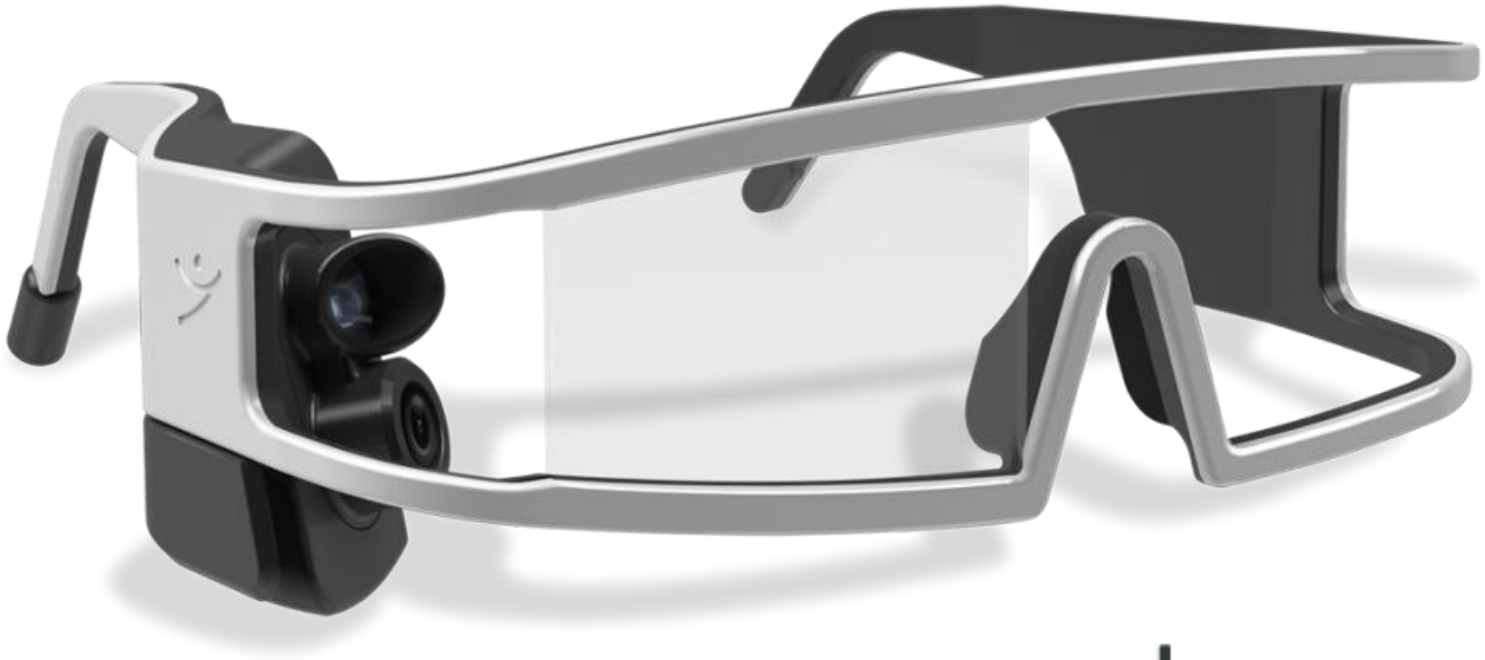
- **based on physiological state of individuals (images of the eye)**
- **and producing a level of drowsiness (task independent)**







First solution: head-mounted system A



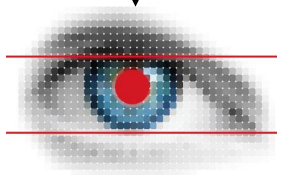
phasya

www.phasya.com

First solution: head-mounted system A

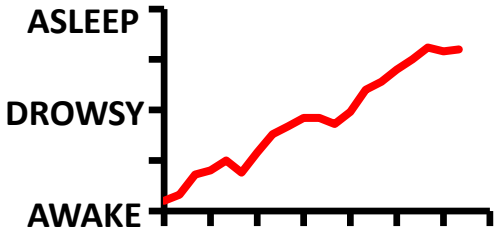
Images of the eye (120 fps)

Eye image processing



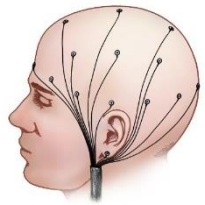
Eyelids distance (0-100 pixels)

LoD* computation



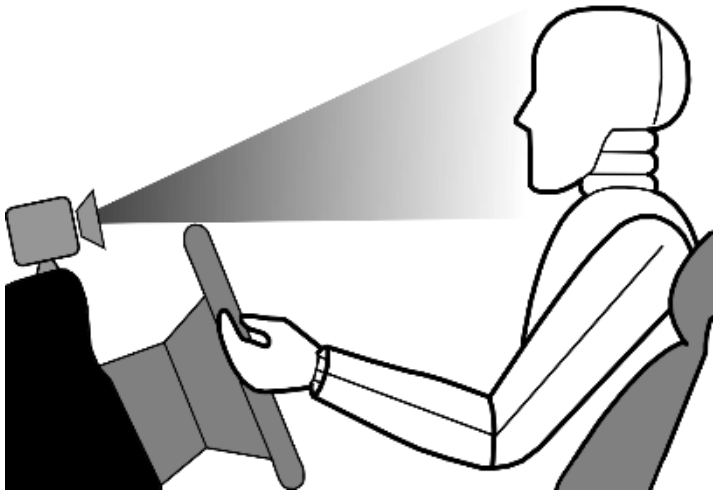
LoD

VALIDATED

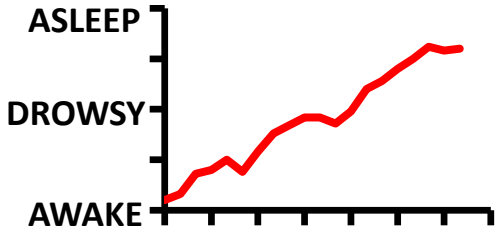


LoD = Level of drowsiness*

Second solution: remote system B

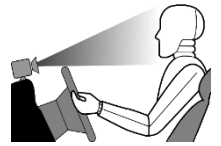


?



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

Method



SYSTEM A

Images of the eye (120 fps)

Eye image processing

Eyelids distance (0-100 pixels)

LoD computation

LoD

SYSTEM B

Images of the face (30 fps)

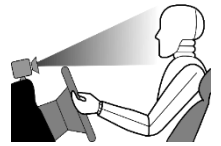
Face image processing

Eyelids distance (0-6 pixels)

?

LoD ?

Method



SYSTEM A

Images of the eye (120 fps)

Eye image processing

Eyelids distance (0-100 pixels)

LoD computation

LoD

TRANSFER ?

SYSTEM B

Images of the face (30 fps)

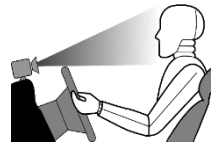
Face image processing

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

Adapter

Eyelids distance (30 fps / 0-6 pixels)

Adapted LoD computation

LoD

SYSTEM B

Images of the face (30 fps)

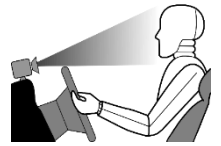
Face image processing

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

Adapter

Eyelids distance (30 fps / 0-6 pixels)

Adapted LoD computation

LoD

SYSTEM B

Images of the face (30 fps)

Face image processing

Eyelids distance (0-6 pixels)

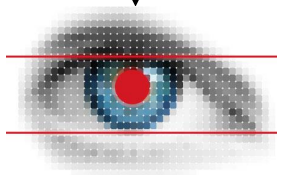
Adapted LoD computation

LoD

Our remote drowsiness monitoring system B

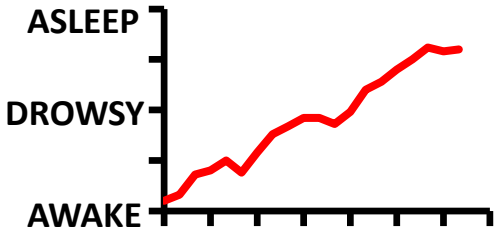
Images of the face (30 fps)

Face image processing



Eyelids distance (0-6 pixels)

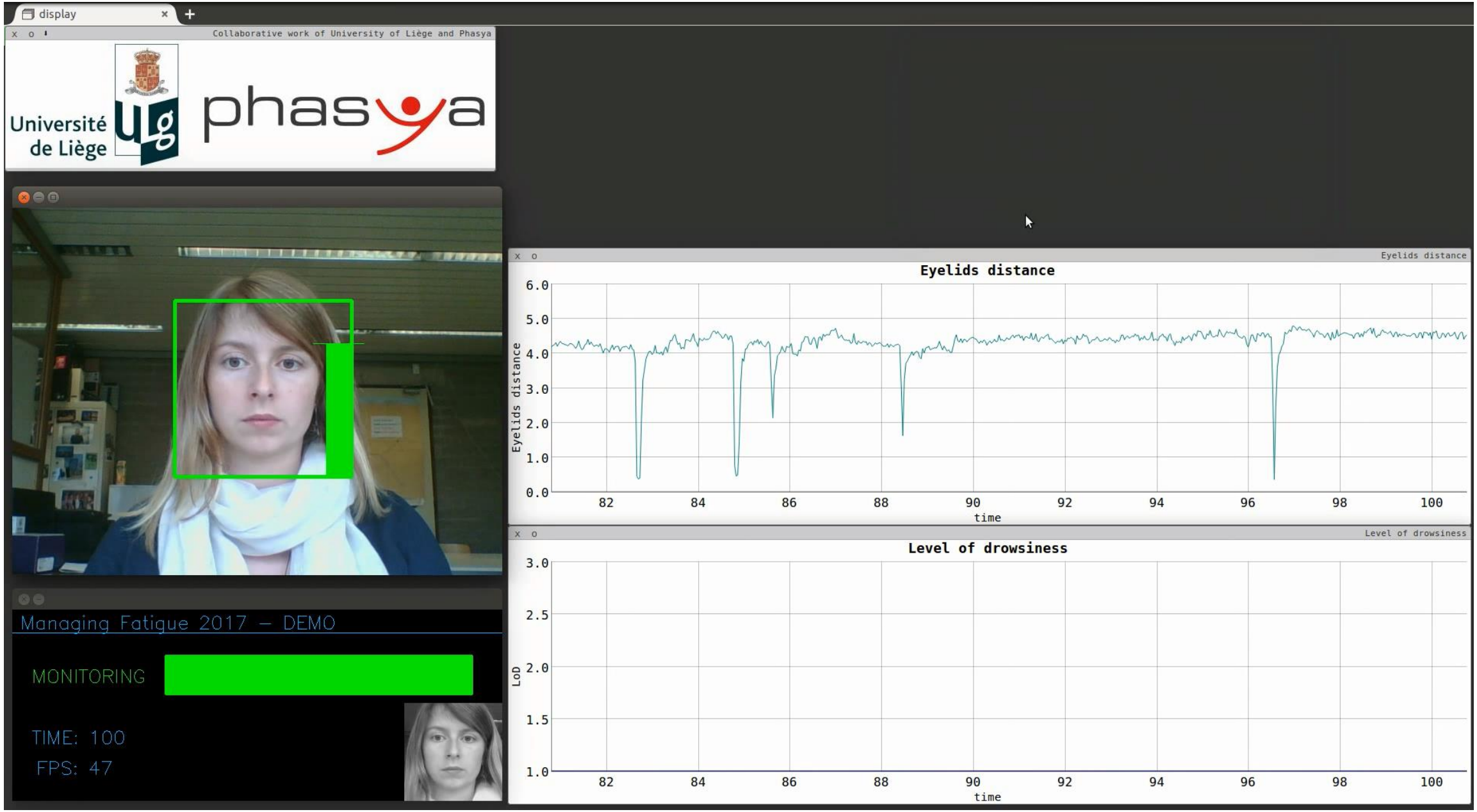
Adapted LoD computation



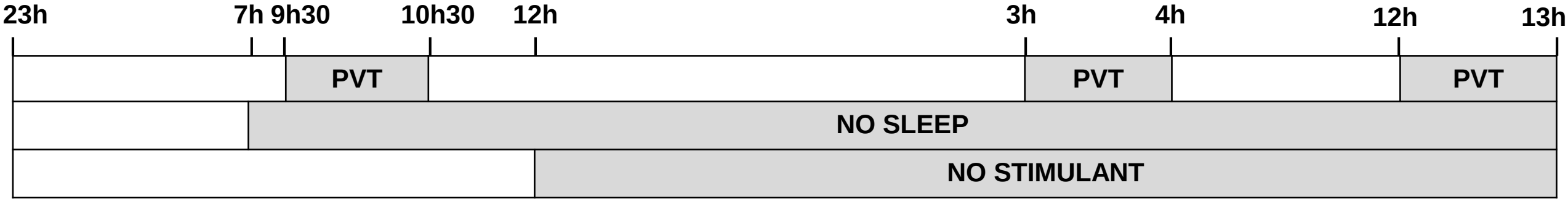
LoD

NEED VALIDATION

Demonstrator: video



Data acquisition



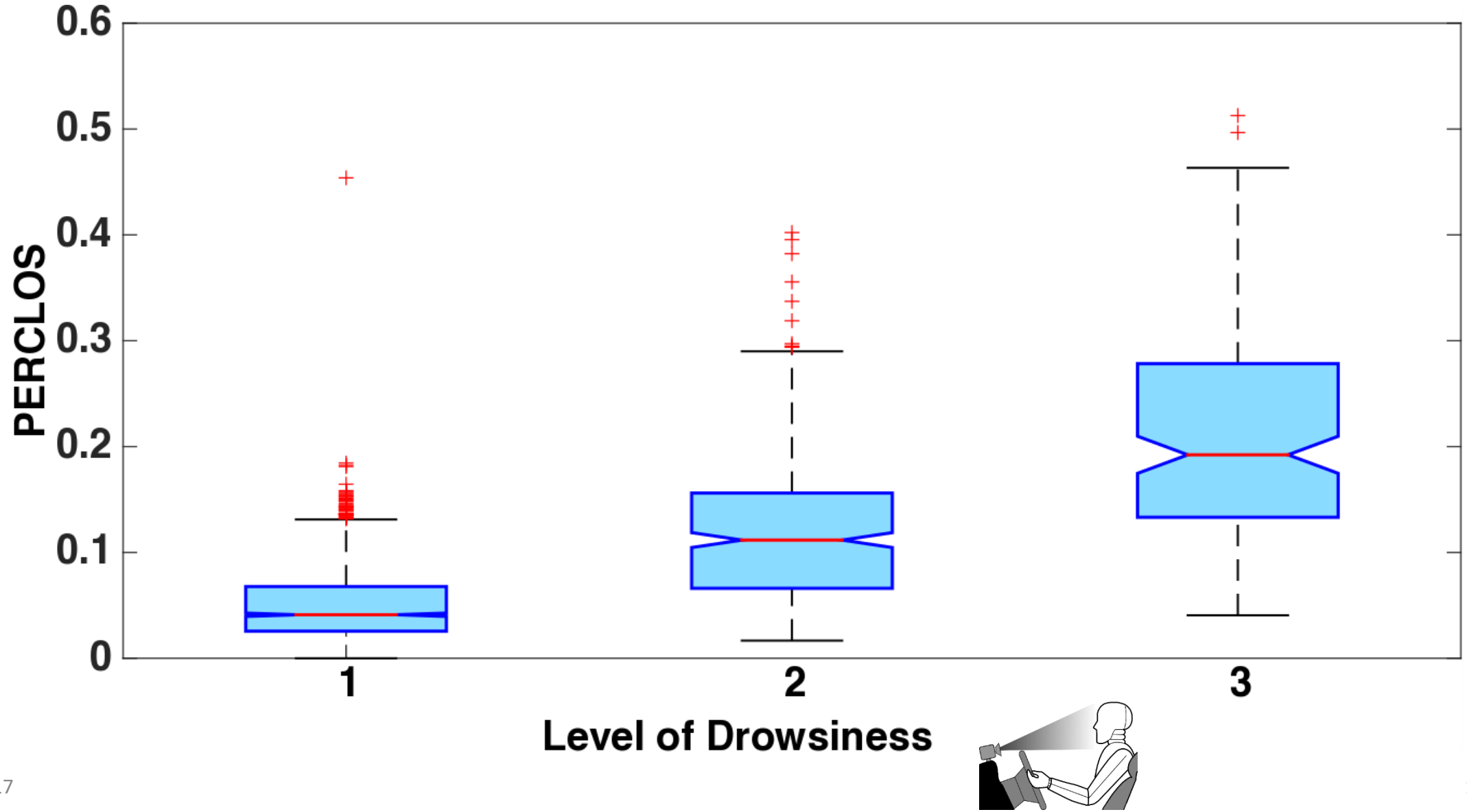
- 35 participants (21F, 14M, mean age: 23.3 yrs, range 19-34 yrs)
- Task = Psychomotor Vigilance Test (duration of 10 minutes)
- Approval by ethics committee
- Data collected:
  - Face images
  - Reaction times

Results

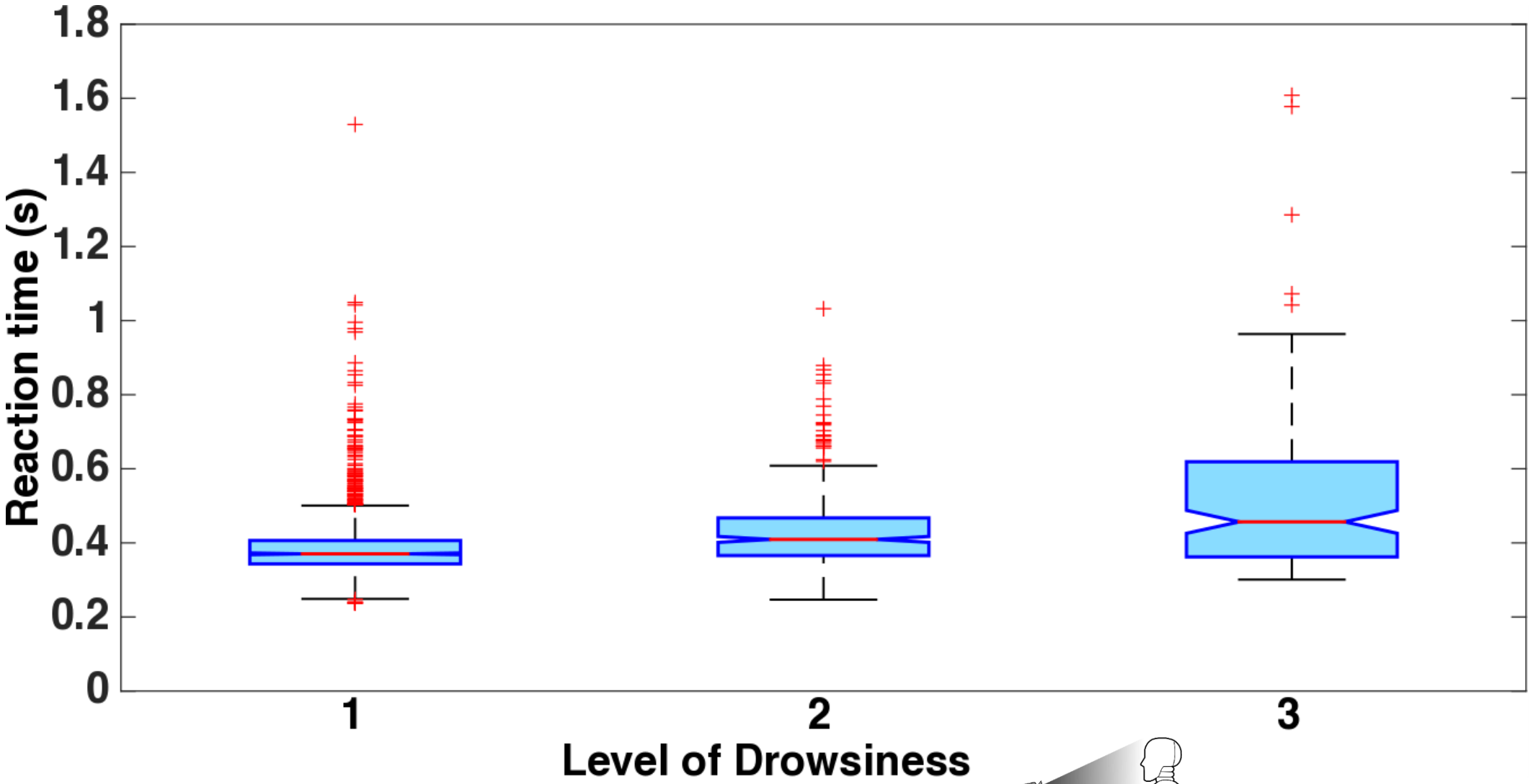
For each 1-min window of each test, we obtained:

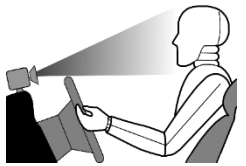
- **LoD determined automatically by our system B**
- **The PERCLOS 70 (Percentage of eye closure)**
- **Mean reaction time (RT)**
- **Percentage of lapses (lapse = RT > 500 ms or no answer)**

Preliminary results (1)

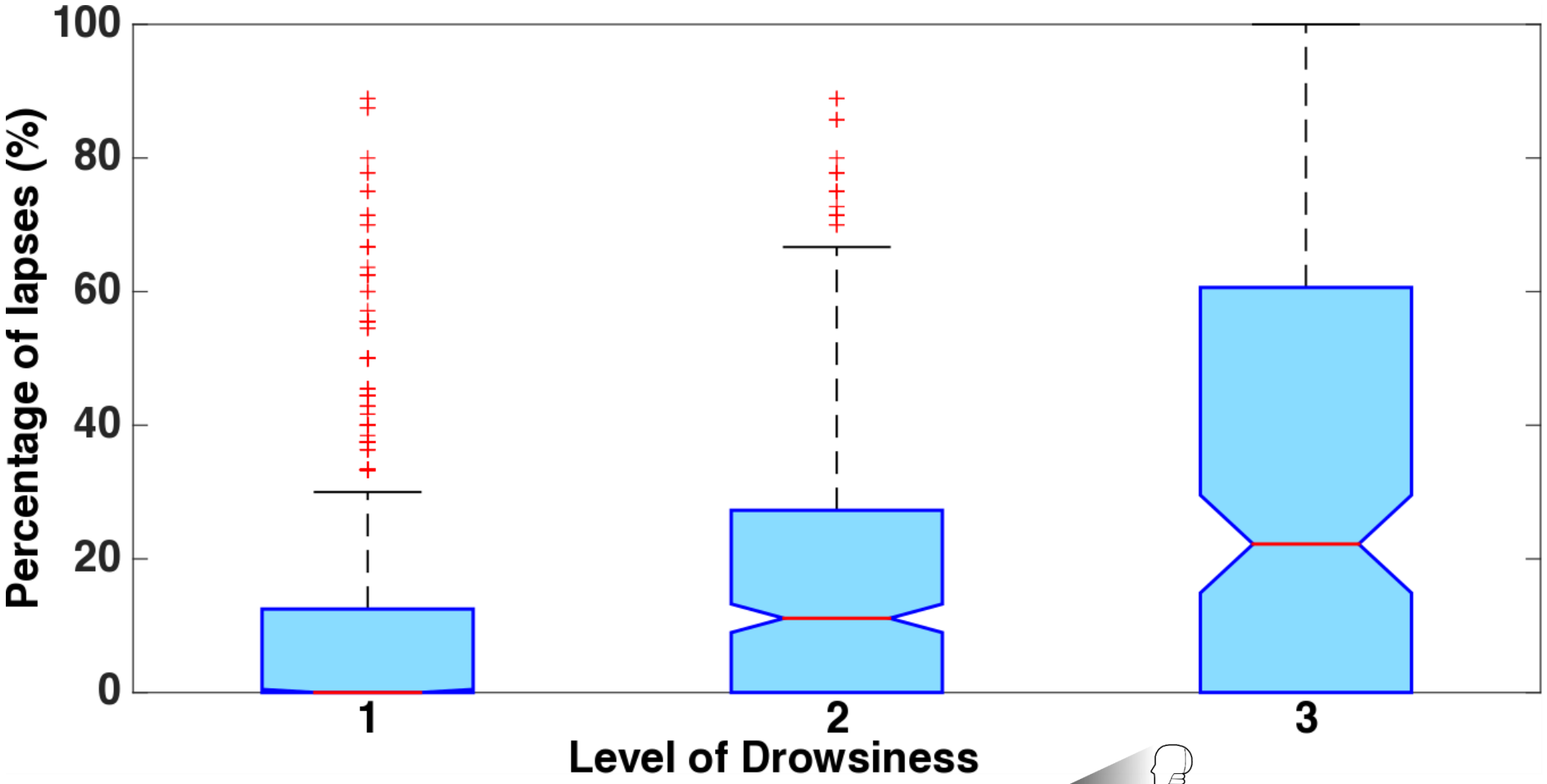


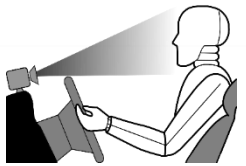
Preliminary results (2)





Preliminary results (3)





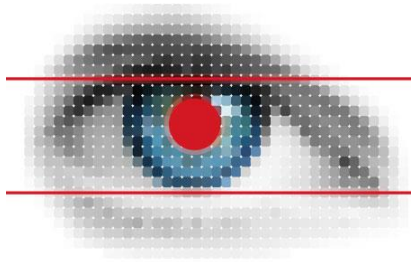
Preliminary results (4)

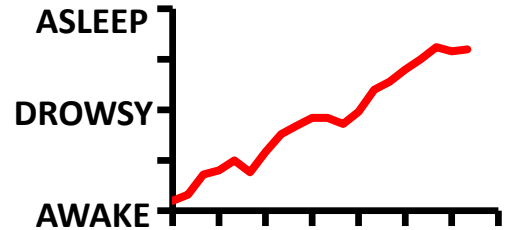
Mean values of PERCLOS, RT, and percentage of lapses as a function of the three LoDs.

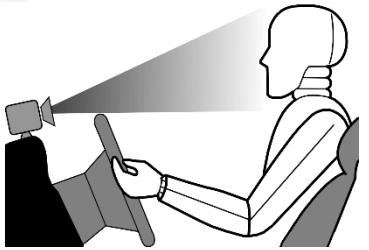
Measures	LoD 1	LoD 2	LoD 3
Mean PERCLOS + SD	0.05 ± 0.03	0.12 ± 0.06	0.21 ± 0.11
Mean RT (s) + SD	0.386 ± 0.151	0.431 ± 0.184	0.518 ± 0.343
Mean percentage of lapses (%) + SD	9.30 ± 14.1	18.2 ± 21.1	31.9 ± 31.8

Conclusion

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

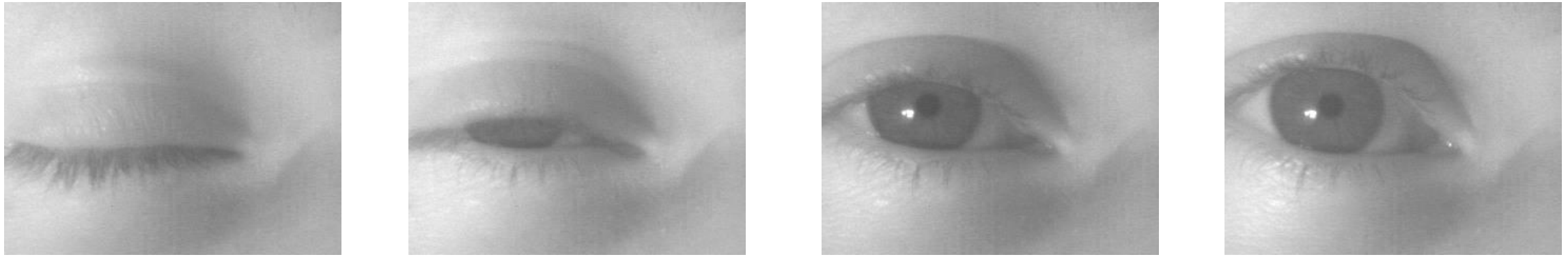






- **Interested in a demo → see Phasya booth.**

Thank you for your attention!



Contact: cfrancois@ulg.ac.be