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

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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
First solution: head-mounted system A

**Images of the eye**
(120 fps)

Eye image processing

**Eyelids distance**
(0-100 pixels)

LoD* computation

LoD

LoD* = Level of drowsiness

VALIDATED

ASLEEP

DROWSY

AWAKE
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)**
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)

Adapter

Adapted LoD computation

LoD

Eyelids distance (30 fps / 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)
    - Adapter
      - Eyelids distance (30 fps / 0-6 pixels)
        - Adapted LoD computation
          - LoD
        - 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)

![Box plot showing reaction times across different levels of drowsiness.](image)
Preliminary results (3)
Preliminary results (4)

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

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

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

• Interested in a demo → see Phasya booth.
Thank you for your attention!

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