Technologies for Autonomous Vehicles Assignment

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Assignment

- Using Python and MediaPipe you are asked to implement the following functionalities:

- Compute EAR and PERCLOS
  - If EAR > 80% for 10 seconds, print an alarm message indicating the driver is drowsy

- Compute Eyes and Head gaze positions using rotation matrices
  - We suggest using 3D calculations for head gaze and 2D calculations for eyes gazes.

- If the combination of Eyes and Head gaze angles differs more than +/- 30° to rest angles (0,0,0), print an alarm message indicating the driver is distracted

- Prepare a short report (3 pages max) to describe the script.

EAR and PERCLOS

Eye Aspect Ratio (EAR)
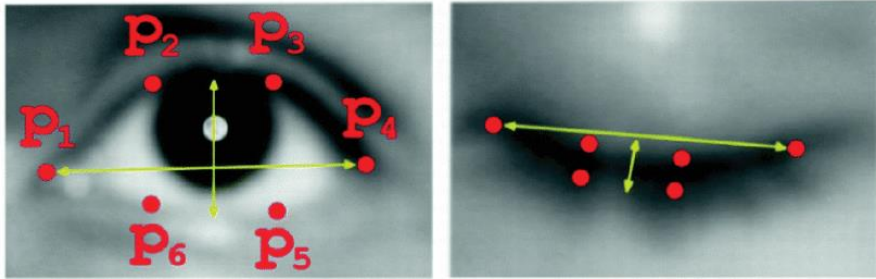
$$\text{EAR} = \frac{|Y_2 - Y_6| + |Y_3 - Y_5|}{2 \cdot |X_1 - X_4|}$$

The vertical (Y-axis) distances between the points p_2, p_3, p_5, and p_6 are calculated for the numerator and the horizontal distance between the points p_1 and p_6 are determined for the denominator.

Whenever a person blinks or closes their eyes, we can observe that the horizontal distance between the points p_1 and p_6 remains the same, while the vertical distance between the points p_2, p_6 and p_3, p_5 will decrease.

PERCLOS

To determine if drivers are drowsy or not it is possible to comply with PERCLOS standard threshold values, which are
- P70 considering the proportion of time when the eyes are closed at least 70 %
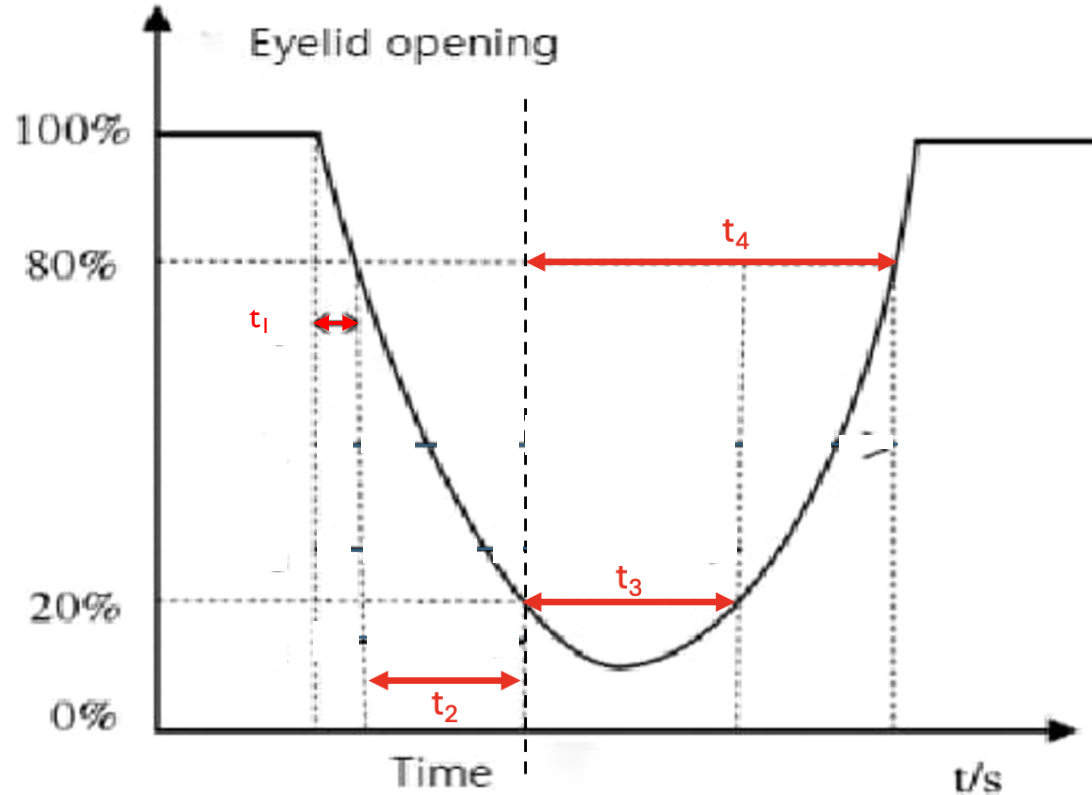- P80 considering the proportion of time when the eyes are closed at least 80 %.

PERCLOS can be computed as:

$$\text{PERCLOS} = \frac{t_3 - t_2}{t_4 - t_1}$$

where:
- t_1 the time that the eyes are open from largest to 80%
- t_2 from 80 % to 20 % open
- t_3 the time from 20 % closed to 20 % open
- t_4 the time of eye opening from 20% to 80% open

A recommended paper on this topic is https://ieeexplore.ieee.org/document/10039811

PERCLOS $t_{\{1\text{-}4\}}$ explanation

$$\text{PERCLOS} = \frac{t_3 - t_2}{t_4 - t_1}$$

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- t_2 from 80% to 20% open
- t_3 the time from 20% closed to 20% open
- t_4 the time of eye opening from 20% to 80% open

Assignment upload instructions

- Are allowed groups of a maximum two people.

- The assignment has to be delivered through the "Portale della Didattica" – "Elaborati" section up to the end of the lecture of this and next week (17/04/2025).

- In case of a group of two people, only one member has to upload it in zip format. The zip archive has to include:
  - the Python script
  - the PDF file of the report.