

Drowsiness Detection using Contactless Heart Rate Monitoring and Eye Tracking

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Goal

Our goal is to accurately measure heart rate variability and eye blink in real time using a webcam or smartphone camera. These two parameters could be used to detect whether someone is drowsy while driving.

Driving while fatigued is very dangerous and leads to 10-30% of road deaths (Rios-Aguilar et al). Biometric indicators are being used to detect drowsiness in drivers and send alerts to boost wakefulness. Ocular indicators such as blink rate, blink duration, and percentage of eye closure can detect sleepiness with accuracy on par with self-reported and performance-based indicators (Ftouni et al). Heart rate variability is another useful indicator, and devices that accurately measure heart rate can reliably detect drowsiness (Rios-Aguilar et al). It is believed that heart rate and ocular indicators can be acquired synchronously to provide a complete assessment of drowsiness in drivers.

Work Flow

Measuring Heart Rate

- Find bounding box for face using cascade classifier
- Separate face region into R,G,B components and spatially average
- Use ICA based on JADE to obtain 3 independent sources
- Pick the component whose power spectrum has the highest peak
- Smooth and bandpass filter the signal
- Interpolate the signal with a cubic spline function
- Filter artifacts using noncausal of variable thresholds
- Report mean of interbeat interval as HR

Measuring Eye Blink Rate and Duration

- Extract and segment eyes from picture of face via OpenCV bounding or template matching
- Determine aspect ratio of the eye not by calculating the orientation and eccentricity of the eye regions
- Keep track of eye aspect ratio for each frame and report whether eyes are closed and for how long they have been closed

Assessing the Accuracy

- Compare heart rate results to heart rate monitor as ground truth
- Manually annotate video of face to determine when eye is open or closed and use as ground truth
- Will also use data from the MAHNOB-HCI database which has video of participants' faces along with various measurements such as ECG

Android Implementation (Tentative)

- Will primarily develop algorithms with Python to work on the computer in real time
- If time permits will try to port algorithms to an Android device as this would be one of the potential use cases

References

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