# Real-Time Driver Drowsiness Detection using Eye Aspect Ratio and Facial Landmarks

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## Abstract

This paper presents a practical, real-time driver drowsiness detection system using a standard webcam, OpenCV, and the dlib 68-point facial landmark model. The system estimates Eye Aspect Ratio (EAR) and optionally Mouth Aspect Ratio (MAR) to detect sustained eye closure and potential yawning. To minimize false alarms, it uses exponential moving average smoothing, a time-based EAR threshold, release margins, and alarm hysteresis. The system runs on CPU-only hardware, provides clear visual overlays and audio alerts (including an immediate stop with a brief 'awake' chime), and includes a Windows-friendly camera backend fallback. Experiments on a laptop webcam demonstrate real-time performance and robust behavior under typical lighting and head pose conditions. While not safety-certified, the design is well-suited for demonstrations, education, and prototyping of driver monitoring features.



## Keywords

Drowsiness detection; EAR; MAR; facial landmarks; OpenCV; dlib; real-time; driver monitoring


## 1. Introduction

Drowsy driving remains a significant safety concern, motivating in-cabin monitoring that can detect fatigue in real time. We implement a low-cost system relying on a standard webcam and CPU, using facial landmarks to compute EAR and MAR as interpretable indicators. The approach emphasizes configurability and ease of deployment while maintaining real-time performance.

## 2. Related Work

Facial landmarks for blink and eye-closure estimation are widely used baselines. PERCLOS and EAR offer lightweight heuristics. Dlib's regression-tree landmark model with HOG-based detection is common, and OpenCV provides real-time video primitives.

## 3. Methodology

We compute EAR from six eye landmarks per eye and average across both eyes. To reduce false positives, we smooth EAR via an exponential moving average and apply a time-based threshold (e.g., 7-10 seconds below threshold signals drowsiness). Recovery is enforced with a release margin and short dwell time to stop the alarm when clearly awake. MAR serves as an optional secondary cue for yawning.

## 4. System Design and Implementation

The pipeline uses OpenCV for capture/display, dlib HOG detector and 68-point predictor for face/landmarks, and largest-face selection. To improve efficiency, detections are reused between frames; on Windows, MSMF to DSHOW to ANY backend fallback is provided. Overlays show status, EAR/MAR, and FPS. Audio uses a looping alarm and a brief 'awake' chime on recovery with immediate-stop control.

## 5. Experiments and Results

On a laptop (CPU-only) with a 720p webcam, the system maintained real-time performance (>=15-20 FPS) and reliably detected sustained eye closure. Parameters (thresholds, durations, smoothing, margin) were tuned for stability, and an optional auto-calibration established a personalized baseline.

## 6. Conclusion and Future Work

We demonstrated a practical, interpretable, and configurable drowsiness detector running in real time on consumer hardware. Future work includes lightweight learning-based classifiers for tougher conditions, multi-session personalization, head-nod/blink-pattern features, and packaging as a desktop app with logs.

## References


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