Fatigue Detection Using Facial Analysis

# Project Overview

This project implements a real-time fatigue detection system using facial landmark analysis. It captures webcam video and analyzes signs of drowsiness such as:  
- Continuous eye closure  
- Frequent yawning  
- Abnormal head tilt  
  
The system uses MediaPipe and OpenCV for landmark detection and video processing.

# Technologies Used

Python - Core programming language  
OpenCV - Video capture and visualization  
MediaPipe - Face mesh and facial landmark detection  
NumPy - Geometric calculations  
VS Code - Code development and execution

# Files Included

fatigue\_detector\_combined.py - Fully integrated script for real-time detection  
eye\_closure\_detection.py - Detects continuous eye closure (EAR method)  
yawn\_detection.py - Detects yawning using lip distance  
head\_tilt\_detetction.py - Detects head tilt using face landmark geometry  
face\_mesh\_test.py - Basic script to test MediaPipe face mesh  
requirements.txt - Lists Python packages required to run the system

# System Features

1. Eye Closure Detection  
- Uses Eye Aspect Ratio (EAR)  
- Triggers an alert if eyes remain closed ≥ 2 seconds

2. Yawn Detection  
- Monitors distance between upper and lower lip  
- Counts yawns using a 60-second time window  
- Triggers an alert if 3 or more yawns detected

3. Head Tilt Detection  
- Measures the tilt angle of the eye line  
- Triggers an alert if head is tilted beyond ±15°

# System Workflow

1. Access webcam stream  
2. Use MediaPipe to detect facial landmarks  
3. Compute EAR, mouth gap, and eye line tilt  
4. Compare with thresholds:  
 - EAR < 0.25 for ≥2 seconds  
 - 3+ yawns in 60s  
 - Tilt > ±15°  
5. Trigger visual alerts on screen.

# Future Improvements

- Add audio alerts for higher visibility  
- Log alert timestamps for performance reports.

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