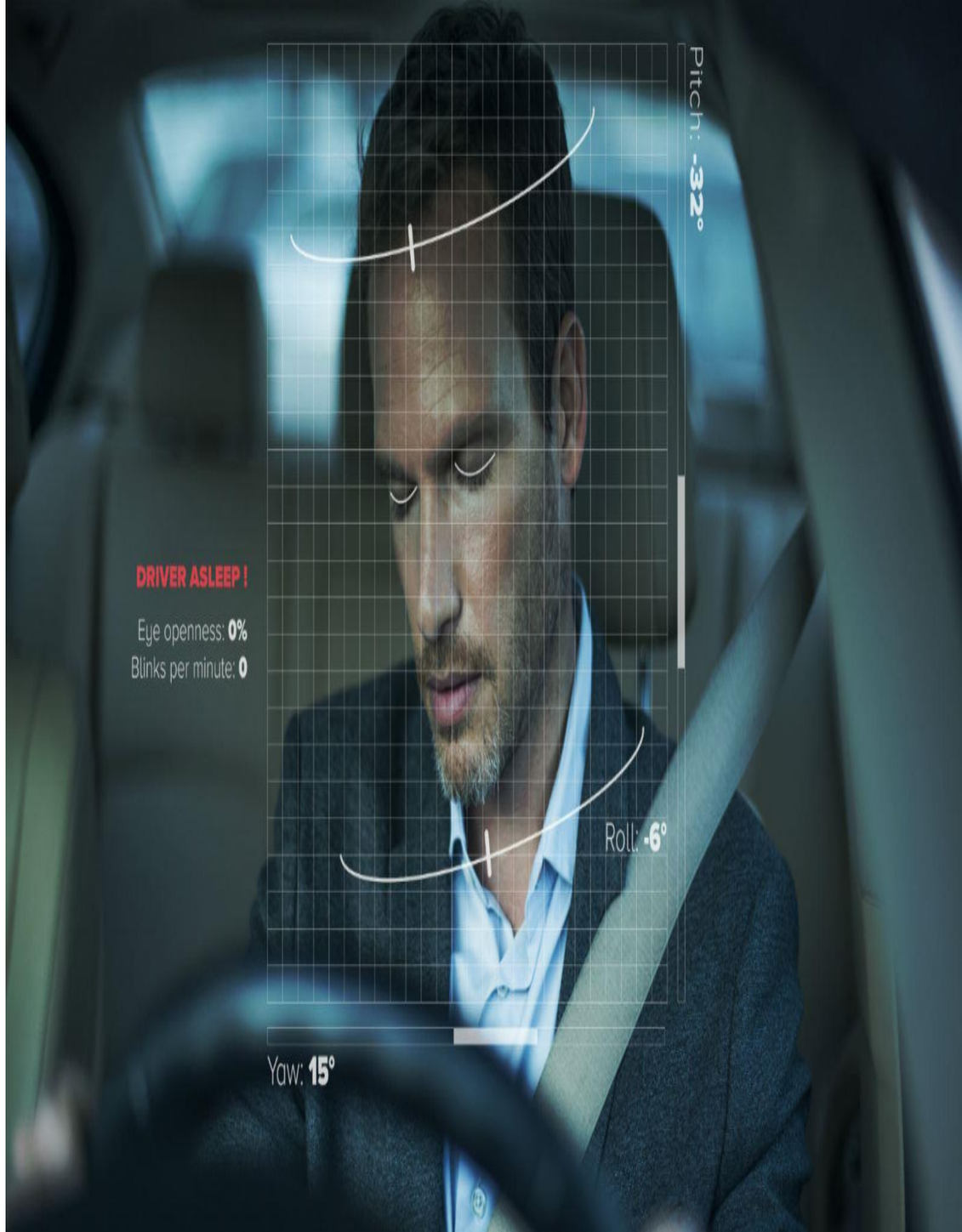
DRIVER DROWSINESS DETECTION SYSTEM

What is Drowsiness?

Drowsiness refers to a state of reduced alertness and wakefulness, often characterized by feelings of sleepiness and fatigue. It can impair cognitive and physical abilities, making it challenging to stay attentive and respond to stimuli effectively.

In the context of driving, drowsiness can be particularly dangerous, as it slows reaction times, decreases focus, and increases the likelihood of errors. This condition is often caused by factors such as insufficient sleep, long hours of monotonous activity, or underlying medical conditions. Recognizing and addressing drowsiness is essential for ensuring safety, especially on the road.



Driver Drowsiness Detection: An ML & Arduino Approach

This project enhances road safety through real-time drowsiness detection. It utilizes machine learning, OpenCV, Face Recognition, and Arduino. The focus is on MAR (Mouth Aspect Ratio) and EAR (Eye Aspect Ratio) for accurate drowsiness detection.

The Dangers of Drowsy Driving

Statistics

Drowsy driving contributes to a significant portion of traffic accidents annually. It accounts for up to 20% of crashes, causing numerous injuries and fatalities.

Real-World Impact

The consequences are severe: loss of life, serious injuries, and substantial economic costs. Families and communities are deeply affected by these preventable accidents.

Current solutions have limitations in real-time accuracy and reliability. Our system aims to address these shortcomings.

Eye Aspect Ratio (EAR)

Definition

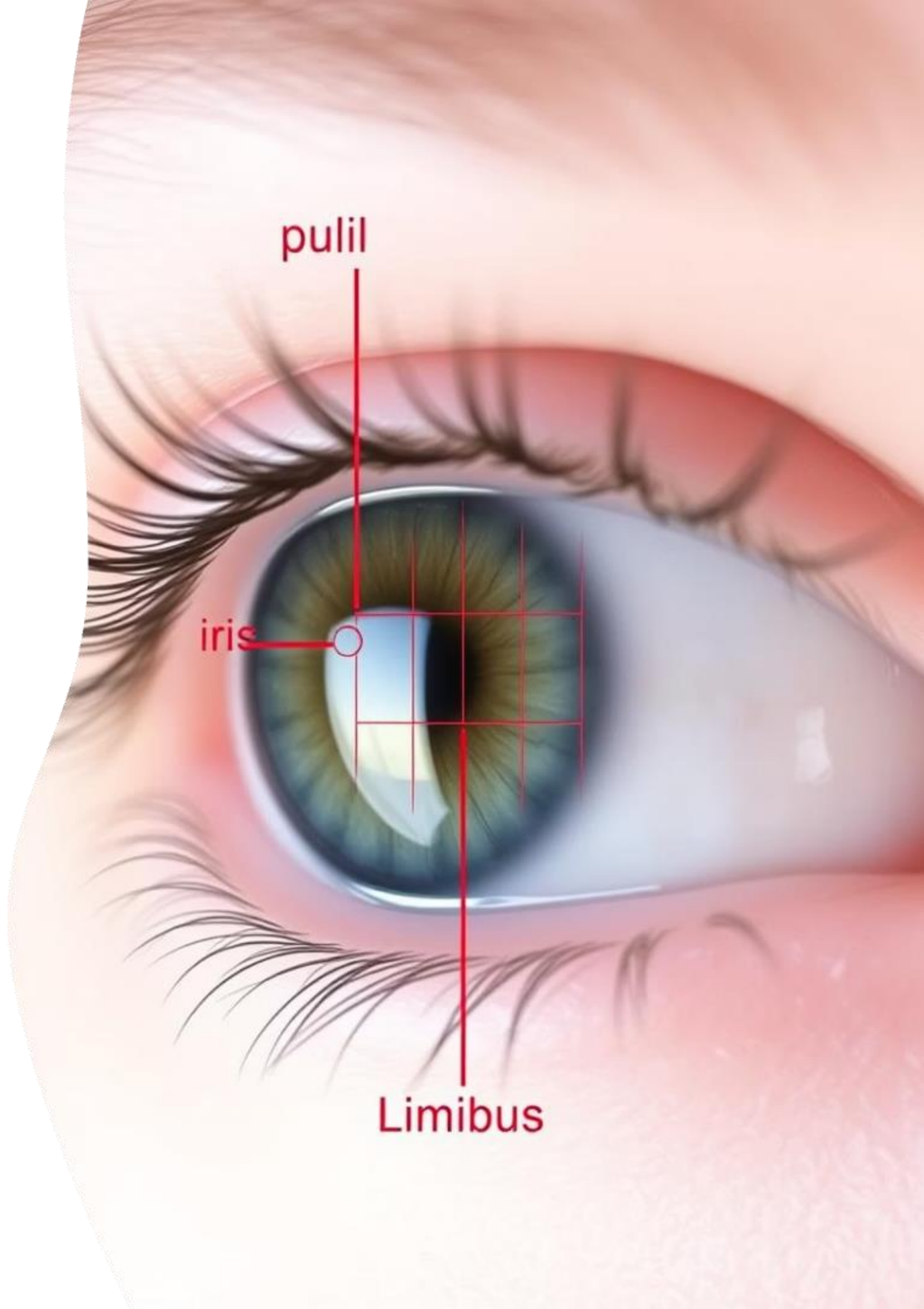
EAR is a mathematical relationship between specific eye landmarks. It quantitatively represents eye openness.

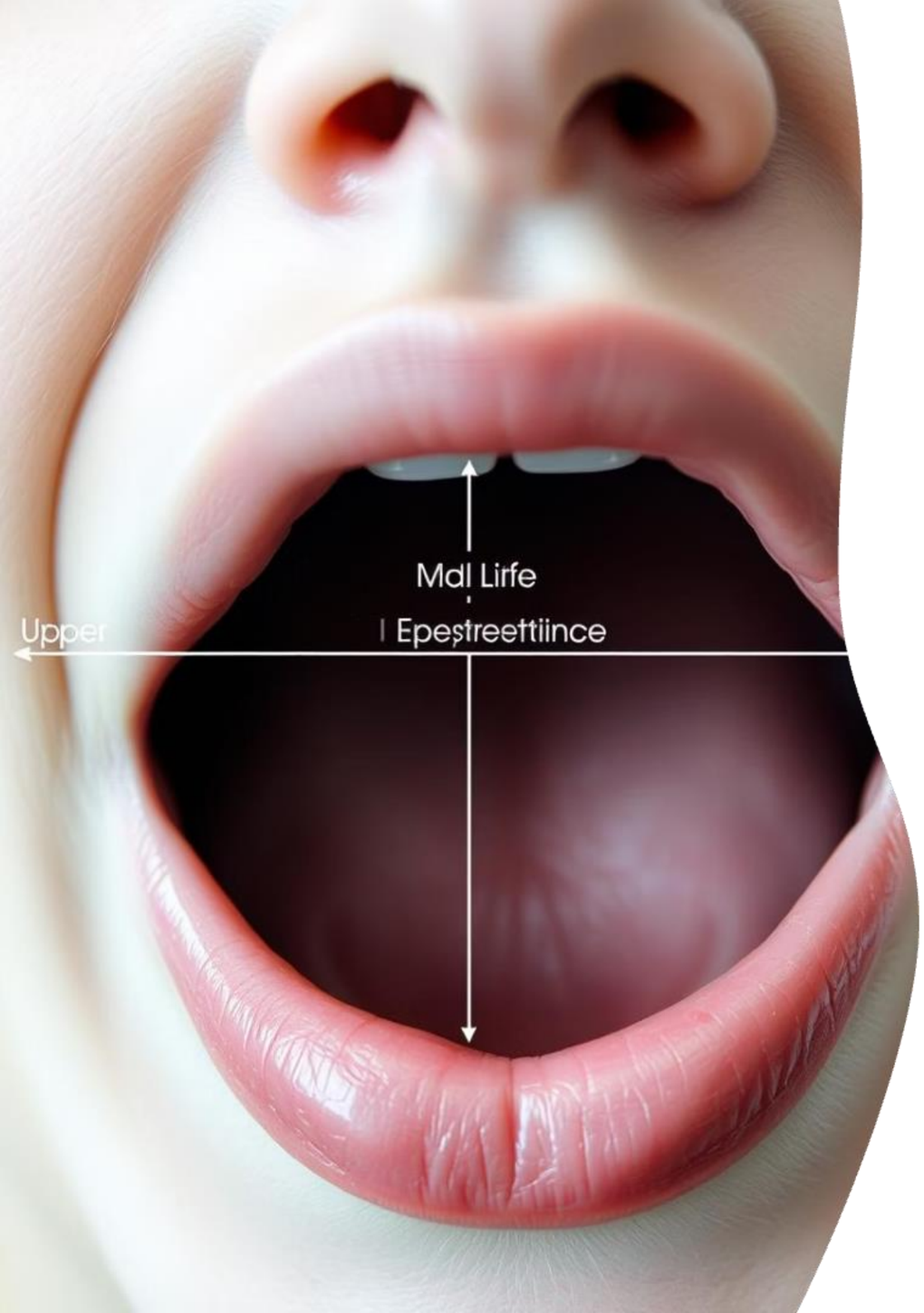
Formula

EAR = (|p2 - p6| + |p3 - p5|) / (2 * |p1 - p4|). This calculates the ratio of vertical to horizontal eye measurements.

Thresholding

An EAR below a set threshold (e.g., EAR < 0.25) indicates drowsiness, triggering an alarm.





Mouth Aspect Ratio (MAR)

Definition

MAR measures mouth openness. It helps detect yawning, a key sign of drowsiness.

Formula

MAR = |p5 - p11| / |p2 - p8|. This formula calculates the ratio of mouth height to width.

Threshold

A MAR above a threshold (e.g., MAR > 0.4) suggests yawning and potential drowsiness, triggering an alert.

Face Detection Approach

Algorithm Choice

We use the **face_recognition** library, which leverages deep learning for accurate facial landmark detection.

Detection Logic

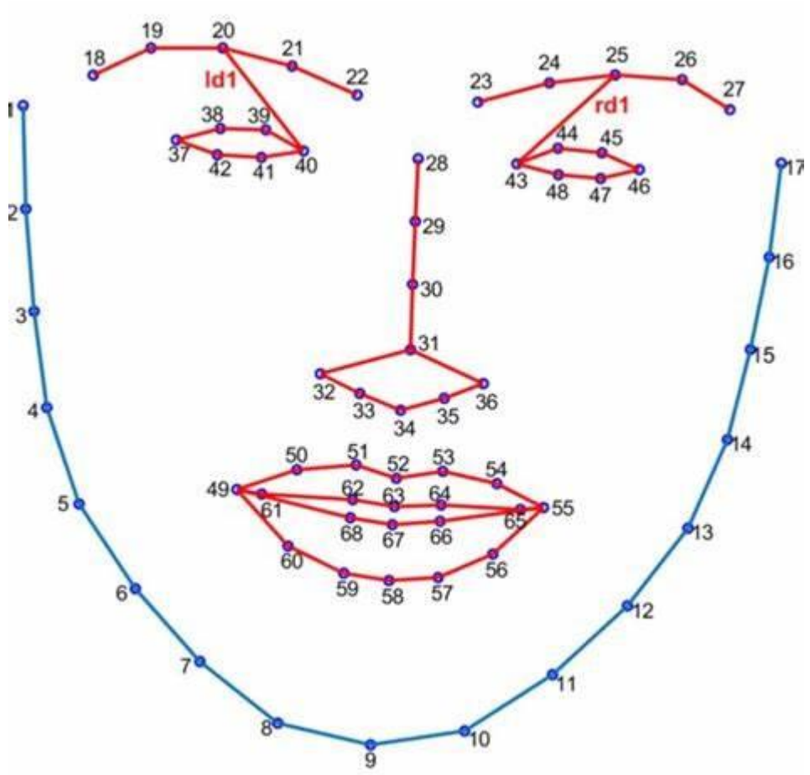
Instead of training a model, we compute Eye Aspect Ratio (EAR) and Mouth Aspect Ratio (MAR) using 68 facial landmarks to infer drowsiness.

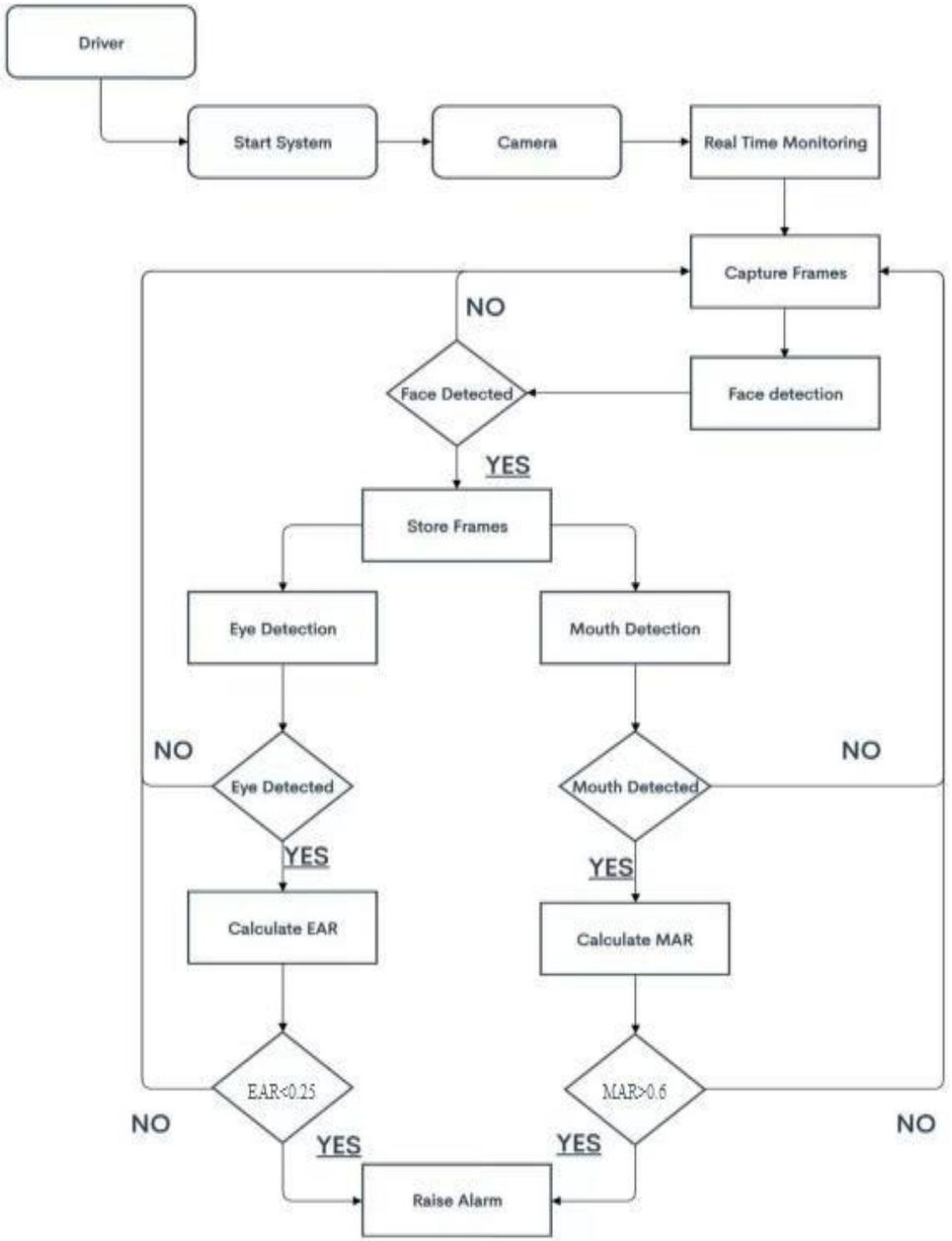
Reliability

By monitoring EAR and MAR thresholds over time, the system achieves reliable and real-time drowsiness detection without explicit training.

Facial Landmark Detection

- The system uses a 68-point facial landmark model to locate key features like eyes and lips.
- This model helps calculate Eye Aspect Ratio (EAR) and Mouth Aspect Ratio (MAR) for drowsiness detection.





System Architecture

Camera Input

Captures real-time video of the driver's face.

Face Detection

Identifies and isolates the driver's face within the video frame.

Feature Extraction

Calculates EAR and MAR values from facial landmarks.

Alert System

Triggers an alert if drowsiness is detected based on EAR/MAR score.

Arduino Integration

Receiving Signal

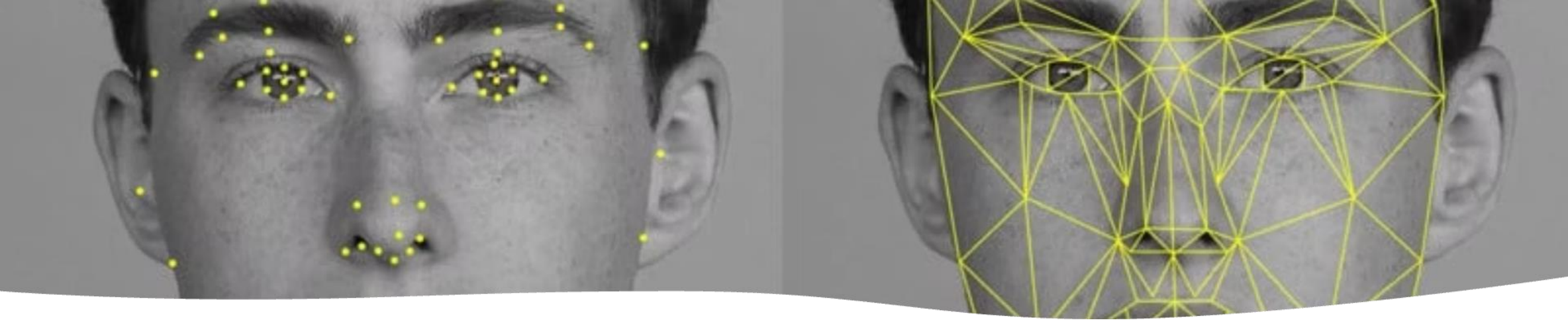
Arduino receives the drowsiness signal from the processing unit.

Triggering Alert

Activates a buzzer, displays a warning message on the LCD, and turns on an LED alert.

Serial Communication

Ensures reliable data transfer between the processing unit and Arduino.



Python Libraries

OpenCV

Real-time face and facial landmark detection.

face_recognition

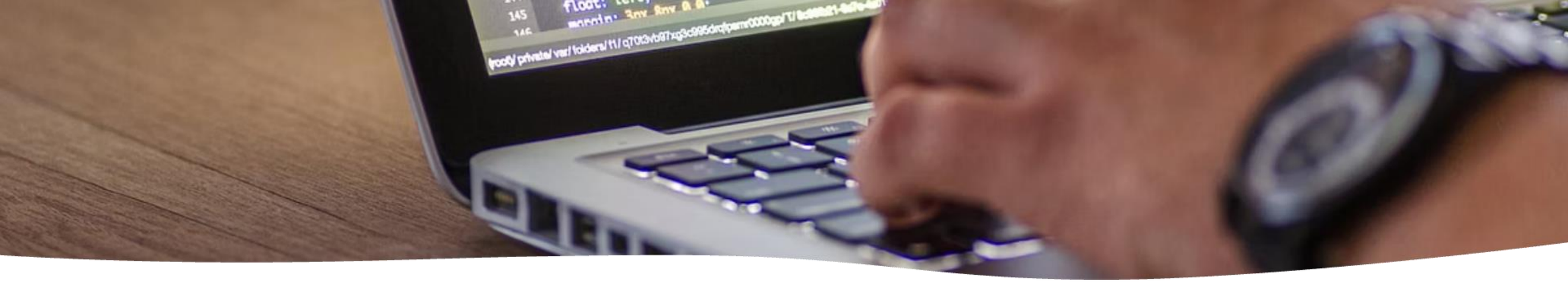
High-accuracy face detection using deep learning.

Pyserial

Reliable serial communication with arduino.

Numpy

Numerical operations for landmark calculations

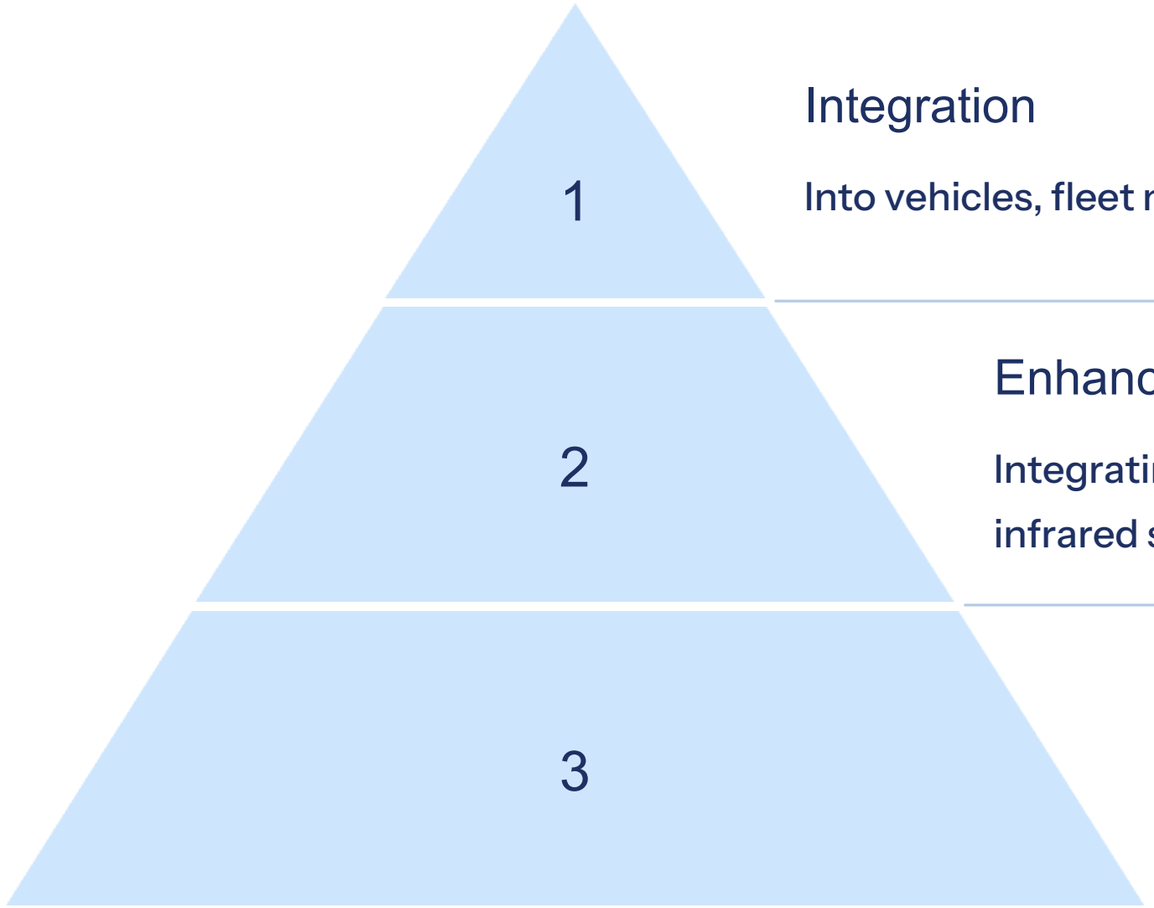


System Testing & Performance

Metric	Observations
Detection Latency	< 1 second (real-time processing)
Drowsiness Response	Alert triggered within 5 continuous frames of signs
Stability	Maintains detection at 720p resolution
Accuracy Indicator	Consistent eye/mouth aspect ratio behavior observed

The system shows reliable and responsive behavior during testing, effectively identifying signs of drowsiness using EAR and MAR. Real-time alerts through Arduino ensure timely user feedback, enhancing road safety potential.

Conclusion and Future Work



Integration

Into vehicles, fleet management systems.

Enhancements

Integrating Heart Rate Variability (HRV) analysis, gaze tracking, and infrared support for better night-time accuracy.

Summary

Successful driver drowsiness detection system.

Promoting road safety through technology is our ultimate goal. By leveraging advanced algorithms, we hope to save lives.


THANK YOU :)