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Facial Landmark-Based System for Early Detection of Driver Fatigue and Safety Alerts

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Abstract: ***Drowsy driving causes road accidents with severe consequences, and drowsiness causes sensory and cognitive impairments. Current systems, however, often base detection on vehicle data and ignore the direct behavior of the driver. Through this project, a non-invasive camera system is introduced that detects driver drowsiness using computer vision to monitor facial features, especially eye and mouth closure. The system detects the driver's faces, extracts facial landmarks, computes the Eye Aspect Ratio (EAR), and computes the Mouth Opening Ratio (MOR) using static and dynamic thresholding techniques. Abnormal EAR or MOR or a hand gesture such as head nodding or mouth covering will immediately trigger an alert for warning the driver. The system thus provides an inexpensive and easy-to-implement solution for increased road safety.***
Keywords: Facial Landmark Localization, Drowsiness Detection, Dynamic Sight Monitoring, Eye Blink, Yawn Detection.

I. INTRODUCTION

Drowsy driving is a basically unsafe mix of sleepiness and tendence to drive. Setting in the backdrop of a driver having insufficient sleeping hours, drowsy driving can be a result of untreated sleep disorders or working late hours. Similarly, the medicines-one's prescription, another over-the-counter-can cause drowsiness, and if coupled with alcohol, drowsiness and impairment multiply. Drowsiness will creep in, provided stress and fatigue manifest on untimely occasions; sometimes due to sleep disorder schemes, certain medications, or simply boredom: driving long hours. The sleepy sensation lowers the level of vigilance, producing dangerous situations with great probability of an accident. One is really unsure of the exact time when sleep will overcome the body. Chatting about falling asleep behind the wheel can never be good: Falling asleep itself is dangerous, but just being tired without actually continuing to sleep hampers your capacity to drive. Drowsiness:

These are some of the effects of alcohol on driving:

- It lessens one's ability to pay attention to the road.
- It slows your reaction time if you have to suddenly hit the brakes or swerve.
- It impairs judgment.

II. PROPOSED WORK

We propose a deep neural network structure specific for the real-time classification of driver behaviour, which we have dubbed Faster Region Convolutional Neural Network (FRCNN). The inputs are multi-stream; that is, side video streams, side optical flows, front video streams, and front optical flows-the fusion layer then joins abstract features extracted by various convolution blocks. Overall, a certain amount of enhancement can be made towards the robustness of this ensemble-based model. The model is divided into two stages. In the first stage, pre-processing operations are applied to the data. The second stage consists of detecting the objects involved in such distracting activities and locating the ROIs of the relevant body parts from the images in the dataset.

III. METHODS

1) Distracted Driver Dashboard We developed a simple, cross-platform action annotation tool for labeling collected videos using Flask, AngularJS, and JavaScript.Users: Vehicle Owner,Admin

2) Driver Face Enrollment and Recognition Driver Face Capturing Module:

Captures driver face images using a webcam or external camera, essential for further emotion detection.

Pre-Processing Module:Converts captured color images to grayscale for efficient processing. Training Module: Creates a dataset by converting images into binary arrays, stored in a compressed .YML file for faster access and processing.

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3) DD Monitoring System DD Enrollment: Registers frontal face images of the vehicle owner, driver, and known individuals. These serve as templates for identifying facial poses like eye open/close and yawning. DD Video Acquisition: Captures driver's frontal face video using a webcam (e.g., Logitech C170) placed 0.6–0.9m from the face. The video is passed to the next module.

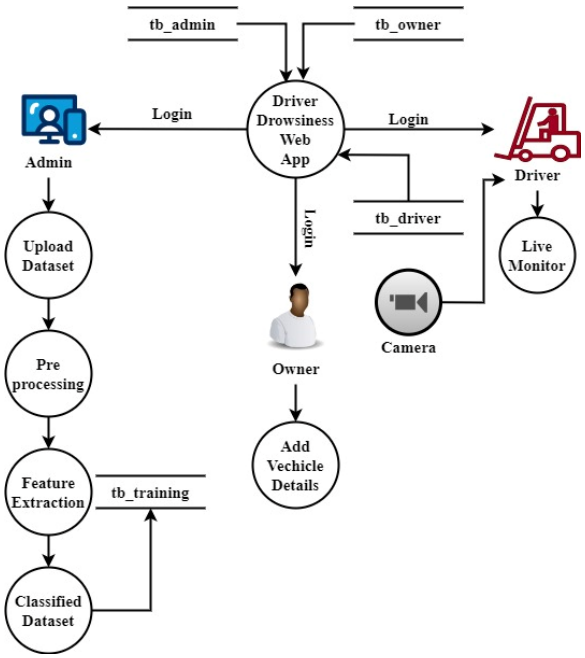
4) DD Prediction Module

After capturing the video from the windshield camera, the DD detection module uses an RPN to identify likely distracted driver (DD) regions. The detected DD image is processed with LBP feature extraction and CNN-based pattern classification. Extracted features are compared to a DD database to classify the driver as Distracted or Normal.

5) Warning system

This module generates alarms, voice alerts, and steering wheel signals when driver drowsiness (eye close or yawning) is detected. It also sends warning emails to the owner for additional driver support.

IV. SYSTEM ARCHITECTURE



V. EXPECTED RESULTS

1) Test Case ID: DDTC001

Input: Start the distracted driving detection system.

Expected Result: System initializes without errors and displays the main dashboard.

Actual Result: System initializes without errors and displays the main dashboard.

Status: Pass

2) Test Case ID: DDTC002

Input: Capture video input of a driver's face with eyes closed.

Expected Result: System detects closed eyes and identifies the driver as distracted.

Actual Result: System accurately detects closed eyes and identifies the driver as distracted.

Status: Pass

3) Test Case ID: DDTC003

Input: Capture video input of a driver's face with mouth yawning.

Expected Result: System detects yawning mouth and identifies the driver as distracted.

Actual Result: System accurately detects yawning mouth and identifies the driver as distracted.

Status: Pass

4) *Test Case ID: DDTC004*
Input: Capture video input of a driver's face with eyes open and mouth closed.
Expected Result: System detects no signs of distraction and identifies the driver as normal.
Actual Result: System accurately detects no signs of distraction and identifies the driver as normal.
Status: Pass

5) *Test Case ID: DDTC005*
Input: Apply various lighting conditions during video capture.
Expected Result: System adapts to different lighting conditions and maintains accurate detection.
Actual Result: System successfully adapts to varying lighting conditions and maintains accurate detection.
Status: Pass

6) *Test Case ID: DDTC006*
Input: Test system response time by capturing video frames at different intervals.
Expected Result: System processes video frames in real-time with minimal delay.
Actual Result: System processes video frames in real-time with minimal delay.
Status: Pass

7) *Test Case ID: DDTC007*
Input: Stress test the system by capturing video input from multiple drivers simultaneously.
Expected Result: System maintains performance and accuracy under high load conditions.
Actual Result: System maintains performance and accuracy under high load conditions.
Status: Pass

8) *Test Case ID: DDTC008*
Input: Test system compatibility with different webcam models and resolutions.
Expected Result: System works seamlessly with various webcam models and resolutions.
Actual Result: System works seamlessly with various webcam models and resolutions.
Status: Pass

9) *Test Case ID: DDTC009*
Input: Perform system updates or changes.
Expected Result: System updates are implemented without introducing new defects.
Actual Result: System updates are implemented without introducing new defects.
Status: Pass

10) *Test Case ID: DDTC010*
Input: Test system integration with email and notification alerts.
Expected Result: System sends alerts and notifications to designated recipients.
Actual Result: System successfully sends alerts and notifications to designated recipients.

These test cases ensure that the distracted driving detection system functions as intended, accurately detecting driver distraction and providing timely alerts when necessary.

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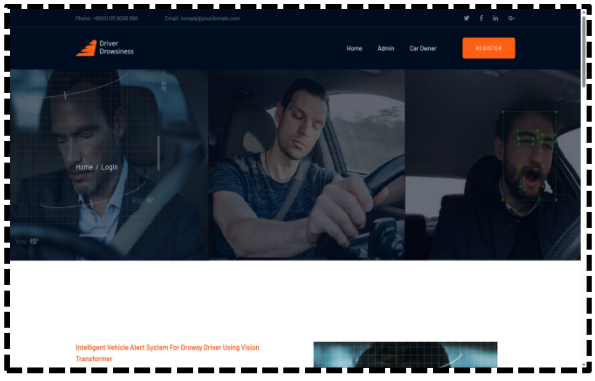

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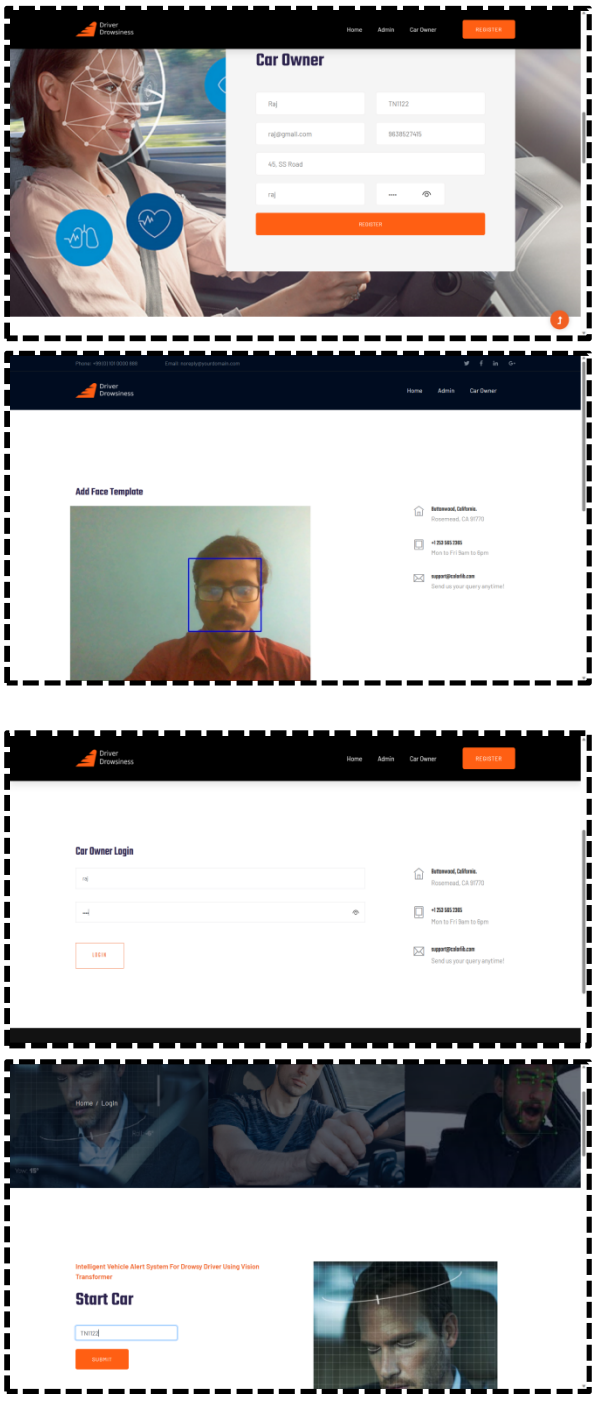

VI. CONCLUSION

The facial landmark-based system for detecting driver fatigue offers an effective and non-intrusive solution to enhance road safety. By continuously monitoring key facial features such as eye closure, yawning, and head position, the system can accurately identify signs of drowsiness or inattention. Leveraging advanced image processing techniques and machine learning models, it ensures real-time detection and timely alerts through visual, audio, and haptic signals. This approach not only minimizes the risk of accidents caused by fatigue but also ensures proactive intervention before the driver's condition worsens. The integration of such a system into vehicles contributes significantly to intelligent transportation systems and supports the broader vision of safer roads and reduced human-error-related incidents

VII. ACKNOWLEDGMENT

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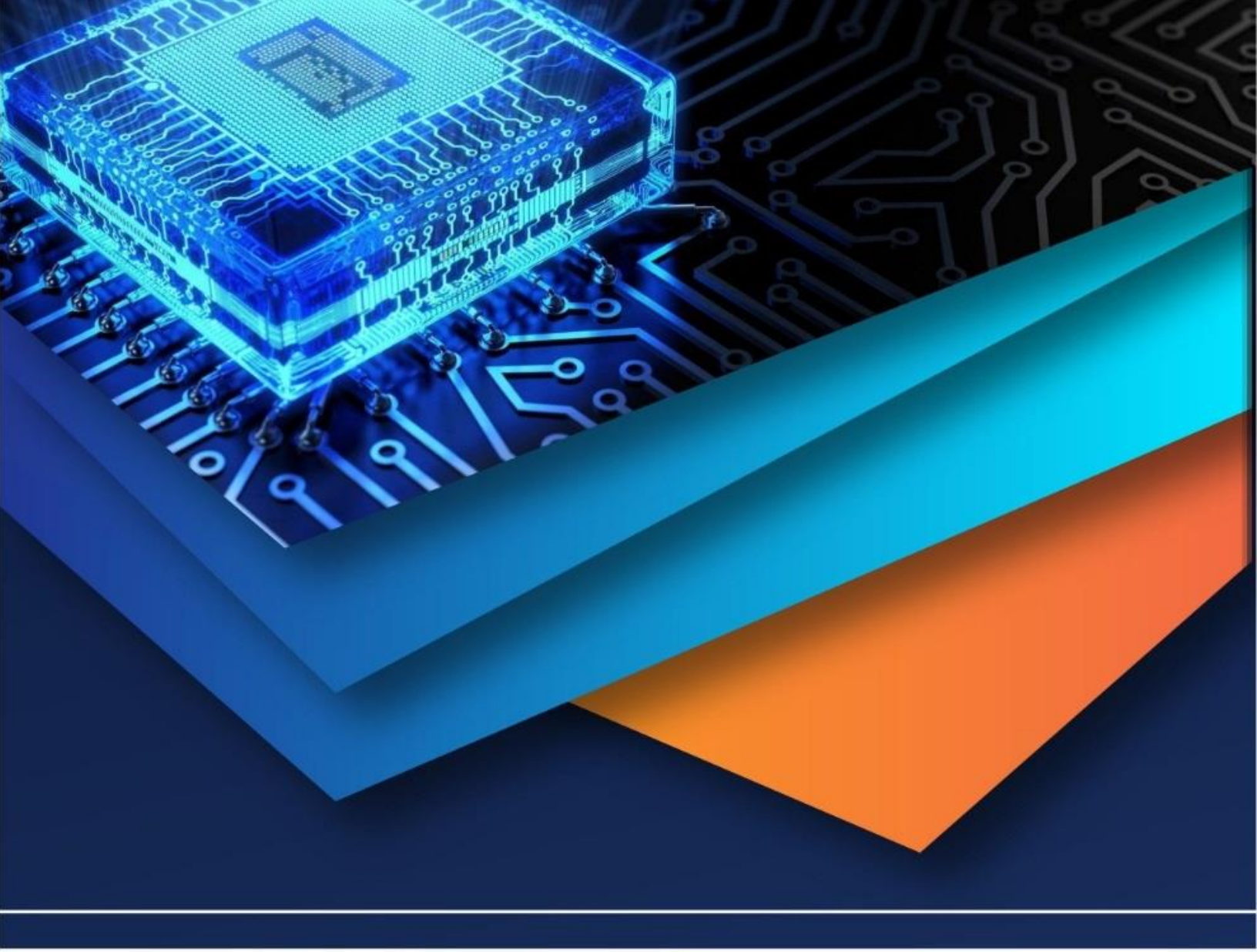

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