REAL TIME DRIVE FATIGUE AND DETECTION RECOGNITION USING COMPUTER VISION

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ABSTRACT - Driver drowsiness and distraction are among the leading causes of road accidents worldwide, necessitating the development of intelligent, real-time monitoring systems to enhance driving safety. This paper presents a non-intrusive Driver Monitoring System (DMS) based on computer vision and deep learning techniques for the detection of driver fatigue and inattentive behavior. The proposed approach leverages a YOLO-powered object recognition framework to identify critical facial regions such as the eyes, mouth, and head orientation from live in-vehicle camera feeds. Key behavioral metrics, including the Percentage of Eye Closure (PERCLOS) and Mouth Aspect Ratio (MAR), are computed to assess alertness levels. The system is designed to operate under varying lighting conditions and diverse driver profiles, providing timely audio or visual alerts upon detecting drowsiness or distraction.

KEYWORDS - Driver Monitoring System, Drowsiness Detection, Distraction Detection, YOLO, Deep Learning, Computer Vision, PERCLOS, MAR, Road Safety, Cyber Security.

1. INTRODUCTION

The rapid growth of intelligent transportation systems and advanced driver assistance technologies has intensified the need for reliable driver monitoring solutions. Driver drowsiness and distraction are major contributors to traffic accidents, often resulting in severe injuries and fatalities. Conventional detection techniques typically rely on physiological sensors such as electroencephalogram (EEG), electrocardiogram (ECG), and heart rate monitors. While these methods provide accurate measurements, they are intrusive, costly, and impractical for continuous real-time deployment in vehicles. In this work, a YOLO-powered deep learning framework is proposed to detect drowsiness.

2. RELATED WORK

Several studies have explored both sensor-based and vision-based approaches for driver monitoring. Kolus (2024) conducted a systematic review highlighting the effectiveness of eye activity measures such as blink rate, eye closure duration, and gaze direction for detecting driver drowsiness. However, the study noted challenges in real-world deployment under diverse environmental conditions.

Alguindigue et al. (2024) proposed a multimodal deep learning framework combining EEG, ECG, and eye-tracking data to improve detection robustness. While accurate, the reliance on wearable sensors reduces user comfort and practical applicability. Madni et al. (2024) introduced a transfer learning-based approach using pre-trained deep neural networks to detect fatigue through eye movement behavior, achieving high accuracy with limited labeled data but showing performance degradation under occlusions such as glasses.

3. PROPOSED WORK

3.1 System Overview

The proposed Driver Drowsiness and Distraction Detection System employs a standard in-vehicle camera to continuously capture live video frames of the driver. The frames are pre-processed and passed to a YOLO-based deep learning model for facial landmark detection. Key regions such as the eyes, mouth, and head position are extracted and analyzed to compute alertness metrics. Based on these metrics, the system determines the driver's state and triggers appropriate alerts in case of fatigue or distraction.

3.2 Data Processing and Preprocessing

The preprocessing stage ensures that the captured video frames are suitable for accurate analysis. The following steps are performed:

- **Frame Extraction:** Converts video streams into sequential frames while preserving temporal consistency.
- **Frame Resizing:** Adjusts image dimensions to match model input requirements.
- **Normalization:** Scales pixel values to improve numerical stability and model performance.
- **YOLO-Based Region Detection:** Identifies critical facial and behavioral regions for focused analysis.
- **Noise Reduction:** Removes visual artifacts to enhance feature clarity.
- **Batching:** Organizes frames into batches for efficient training and inference.

3.3 Feature Extraction and Classification

YOLO is employed to detect and localize key facial landmarks in real time. From the detected regions, behavioral metrics such as PERCLOS and MAR are computed to quantify eye closure and mouth movement patterns. These features are analyzed to determine the driver's alertness level and classify the state as alert, drowsy, or distracted.

3.4 Alert Generation Module

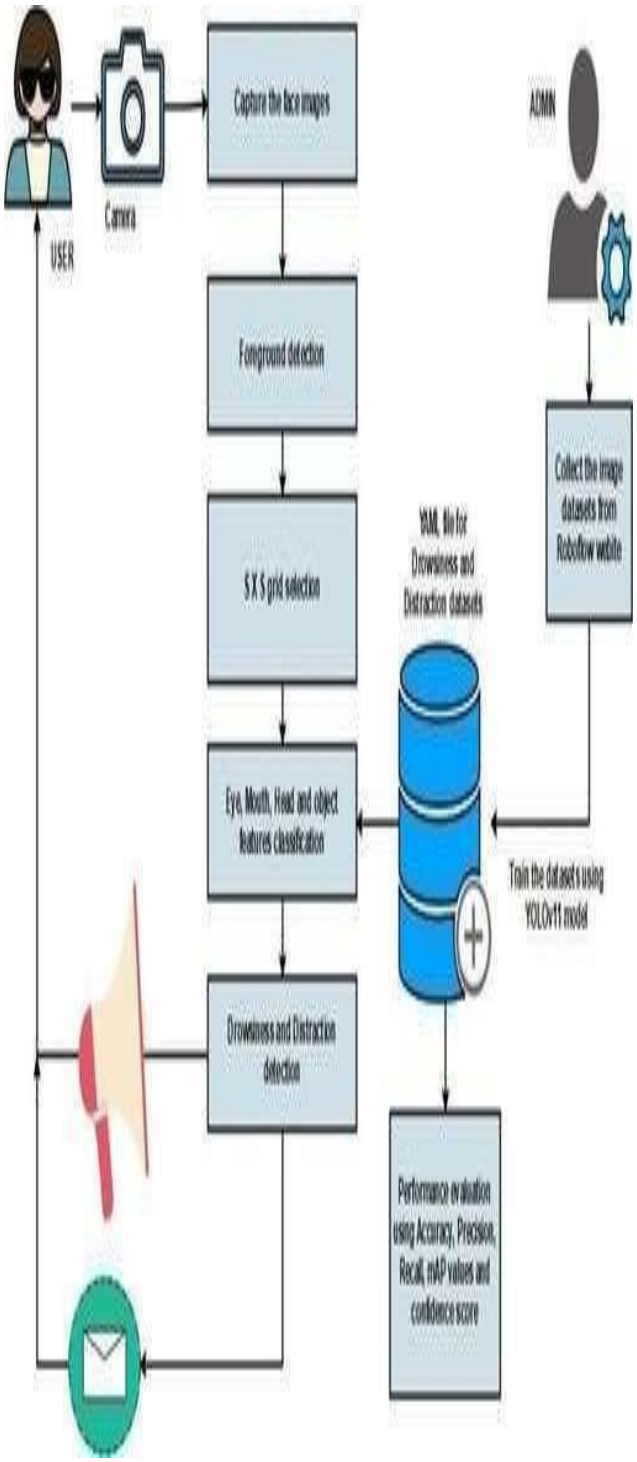
Upon detecting abnormal driver behavior, the system triggers an alert module that provides immediate feedback through audio or visual signals. This mechanism aims to refocus the driver's attention and prevent potential accidents.

3.5 TOOLS AND TECHNOLOGIES

The system is implemented using the following tools and libraries:

- **Python:** Primary programming language for system development.
- **YOLO:** Real-time object detection framework for facial region identification.
- **OpenCV:** Handles video capture, frame extraction, and image processing.
- **TensorFlow / Keras:** Deep learning framework for model training.
- **NumPy and Pandas:** Support numerical computations and data manipulation.
- **MYSQL:** Backend database for storing system logs and performance data.

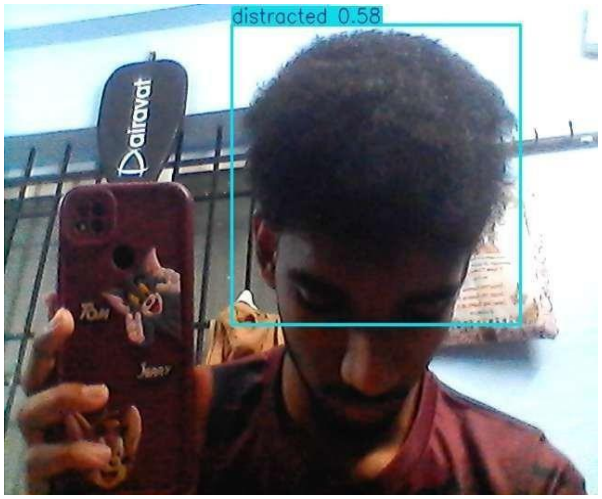
3.6 SYSTEM ARCHITECTURE

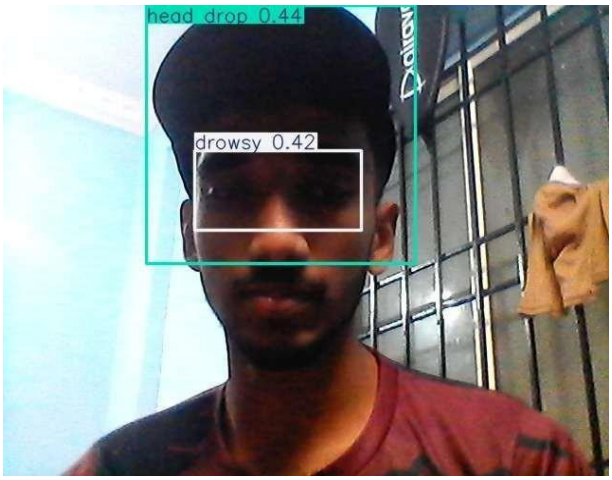


4. PROGRAM

```
from flask import Flask, request, session, render_template
import mysql.connector, cv2
from ultralytics import YOLO

app = Flask(__name__)
app.config['SECRET_KEY'] = "key"

def db():
    return mysql.connector.connect(user="root", password="", host="localhost", database="1drowsydbyolo")

@app.route("/driverlogin", methods=["POST"])
def driverlogin():
    u, p = request.form["uname"], request.form["password"]
    con = db(); cur = con.cursor()
    cur.execute("SELECT * FROM regtb WHERE UserName=%s AND Password=%s", (u, p))
    data = cur.fetchone()
    if not data: return "Invalid Login"

    session["email"], session["mob"] = data[3], data[2]
    model = YOLO("runs/detect/Driver/weights/best.pt")
    cap, count = cv2.VideoCapture(0), 0

    while cap.isOpened():
        ok, frame = cap.read()
        if not ok: break
        results = model(frame, conf=0.4)
        for r in results:
            if r.boxes:
                cls = int(r.boxes[0].cls)
                if model.names[cls] != "awake":
                    count += 1
                if count == 50:
```

5. RESULTS AND OUTPUT





Driver Drowsiness Detection Results: The system successfully detects driver drowsiness by analyzing facial features such as eye closure and head orientation. In the observed frames, the model identified drowsy behavior with a confidence score of 0.42, indicating partial eye closure and reduced alertness. This confirms the effectiveness of PERCLOS-based analysis in real-time conditions.

- **Driver Distraction Detection Results:** The proposed YOLO-based model accurately recognized distracted behavior when the driver's attention deviated from the road. As shown in the output image, the system detected distraction with a confidence score of 0.58, highlighting head movement and gaze deviation as key indicators.

- **Head Drop and Fatigue Analysis:** Head posture analysis played a crucial role in fatigue detection. The system identified head drop behavior with a confidence score of 0.44, which is a strong indicator of driver fatigue and reduced situational awareness during driving.

- **System Performance and Reliability:** The system achieved stable real-time performance with minimal latency, making it suitable for continuous monitoring. The detection accuracy observed in live camera feeds validates the practicality of the proposed approach for real-world deployment.

6. CONCLUSION

This paper presents a real-time, non-intrusive Driver Monitoring System based on YOLO-powered object recognition and deep learning techniques. By analyzing facial landmarks and behavioral metrics such as PERCLOS and MAR, the system accurately detects driver drowsiness and distraction. The proposed architecture offers high detection accuracy, reduced computational complexity, and scalability for deployment in modern vehicles. The results highlight the potential of computer vision-based solutions in enhancing road safety and contributing to the advancement of intelligent transportation systems.

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