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DROWZISHIELD: An AI-Based Real-Time Driver Drowsiness and Pedestrian Detection System

ADITYA KHARADE[1], SARTHAK SHINDE[2], SARVESH WANI[3], KALPANA GANGWAR[4]
[1,2,3,] *Department of Computer Engineering, New Horizon Institute of Technology and Management Thane, Maharashtra, India*
[4]*Guide, Department of Computer Engineering, New Horizon Institute of Technology and Management Thane, Maharashtra, India*

Abstract- Road accidents caused by driver fatigue and pedestrian collisions are a major concern worldwide. Drivers often become drowsy during long journeys, which reduces their concentration and reaction time, increasing the risk of accidents. Pedestrians are also among the most vulnerable road users and are often involved in road accidents due to delayed driver response. The proposed system, DROWZISHIELD, is an AI-based safety system that detects driver drowsiness and pedestrians in real time using computer vision techniques. The system monitors the driver's facial features to detect fatigue and simultaneously analyzes the road environment to identify pedestrians using object detection models. When the system detects a risky situation, it generates alerts to warn the driver. This approach enhances road safety by improving driver awareness and preventing potential accidents.

Index Terms— Artificial intelligence, computer vision, driver drowsiness detection, pedestrian detection, road safety, YOLO, OpenCV

I. INTRODUCTION

Road safety is one of the major challenges faced by modern transportation systems. A significant number of accidents occur due to driver fatigue and lack of attention, especially during long-distance driving. When a driver becomes drowsy, the ability to react quickly to road conditions decreases significantly. In addition to driver fatigue, pedestrians are often exposed to high risk on roads due to delayed driver response. Therefore, detecting pedestrians in time can help prevent serious accidents.

The DROWZISHIELD system addresses these issues by combining driver monitoring and pedestrian detection using artificial intelligence and computer vision techniques. The system continuously analyzes the driver's eye movement and facial landmarks to detect signs of fatigue while simultaneously detecting pedestrians using an object detection model. The primary objective of this system is to identify driver fatigue by analyzing facial features and eye movements. Furthermore, it aims to detect pedestrians on the road and generate timely alerts whenever a dangerous situation is identified, thereby improving overall road safety.

The implementation of the system consists of multiple modules. The driver drowsiness detection module detects the driver's face and monitors eye movement using facial landmark detection, where the Eye Aspect Ratio (EAR) is calculated to determine whether the driver is drowsy. The pedestrian detection module utilizes the YOLOv8 deep learning algorithm to identify pedestrians within the video stream. When a pedestrian is detected, a bounding box is drawn around the person, and the system generates warning alerts in critical situations. Finally, the visualization interface displays the live video feed with detection results, bounding boxes, and alerts in real time.

II. DATASET DETAILS

The project primarily uses real-time video input from a camera for monitoring driver behavior and road conditions. However, the object detection model used for pedestrian detection is trained using publicly available datasets. Dataset sources include the COCO Dataset for pedestrian detection and facial landmark datasets used by MediaPipe for face and eye detection. The COCO dataset contains over 330,000 images with multiple object classes, including the

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person class, which is used for pedestrian detection in this project.

III. ALGORITHMS AND MODELS USED

I. Driver Drowsiness Detection
- Facial Landmark Detection
- Eye Aspect Ratio (EAR)

II. Pedestrian Detection
- YOLOv8 Object Detection Model

III. Additional Techniques
- Computer Vision
- Real-time Video Frame Processing

IV. TOOLS AND TECHNOLOGIES USED

I. Programming Language
- Python

II. Libraries
- OpenCV
- MediaPipe
- Ultralytics YOLOv8
- NumPy

III. Development Tools
- VS Code / Cursor
- Python Virtual Environment
- GitHub

IV. Hardware
- Webcam / Camera
- Laptop or PC

V. SYSTEM ARCHITECTURE / WORKFLOW

1. The camera captures real-time video input.
2. The system captures the driver's facial region and tracks eye activity in real time.
3. Eye Aspect Ratio is calculated to determine drowsiness level.
4. The YOLOv8 model processes video frames to detect pedestrians.
5. If the system detects a risk condition, alerts are generated.
6. Detection results are displayed on the screen in real time.

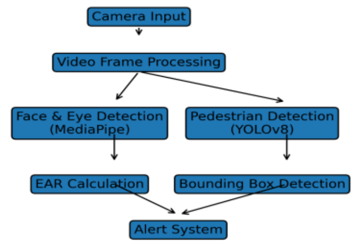

Fig 1. System architecture. the overall architecture of the drowzishield system showing the integration of drowsiness detection and pedestrian detection modules.

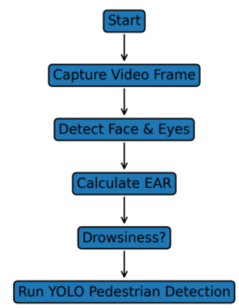

Fig 2. System workflow. the end-to-end workflow of the drowzishield system from real-time video input to alert generation.

VI. IMPLEMENTATION

The implementation of the system consists of multiple modules. The driver drowsiness detection module detects the driver's face and monitors eye movement using facial landmark detection. The Eye Aspect Ratio (EAR) is calculated to determine whether the driver is drowsy. The pedestrian detection component leverages the YOLOv8 model to recognize individuals within the video feed.. When a pedestrian is detected, a bounding box is drawn around the person. The alert system generates warning alerts whenever the driver is detected to be drowsy or when pedestrians are detected near the vehicle. The visualization interface displays the live video feed with detection results, bounding boxes, and alerts.

The Eye Aspect Ratio (EAR) plays a crucial role in detecting driver drowsiness. It is calculated using the distances between key eye landmarks. When the eyes are open, the EAR value remains relatively constant; however, when the eyes close, the value decreases significantly. Therefore, by continuously monitoring this ratio, the system can accurately determine whether the driver is drowsy.

Similarly, the YOLOv8 model is used for pedestrian detection due to its high speed and accuracy. YOLO divides the input image into grids and predicts bounding boxes along with class probabilities in a single pass. Consequently, this approach enables real-time detection, which is essential for safety-critical applications like this project. Moreover, YOLOv8 improves detection performance by using advanced deep learning techniques, making it suitable for real-world scenarios.

VII. RESULTS AND ANALYSIS

The DROWZISHIELD system was tested using real-time video input from a camera under different conditions. The system successfully detected driver eye closure patterns and identified pedestrians in the camera frame. Moreover, the system was able to operate efficiently in real time with minimal delay, ensuring timely alerts.

The drowsiness detection module showed consistent performance when the driver's face was clearly visible. Similarly, the pedestrian detection module accurately detected multiple pedestrians in different environments. However, slight variations in performance were observed under low-light conditions and when the face was partially occluded.

Overall, the system demonstrated reliable performance and effectively generated alerts in critical situations. Therefore, it can be concluded that the proposed system significantly improves driver awareness and reduces the risk of accidents.

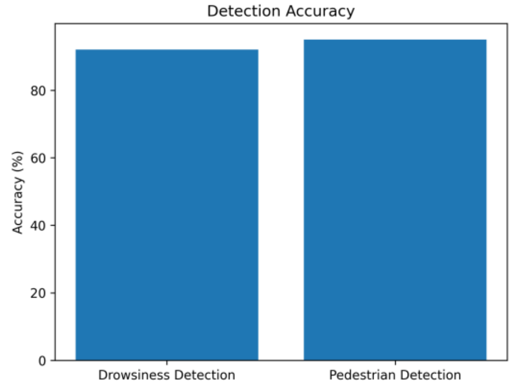

Fig 3. Detection accuracy. detection accuracy of the proposed drowsiness and pedestrian detection modules.

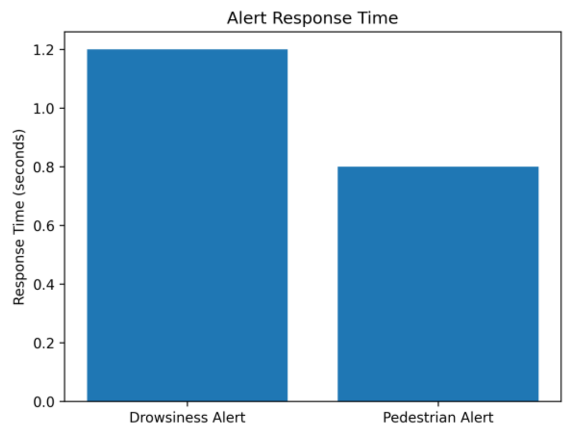

Fig 4. Alert response time. average response time of the alert system under different detection scenarios.

VIII. CONCLUSION

The DROWZISHIELD system demonstrates how computer vision and artificial intelligence can be used to improve road safety. By detecting driver drowsiness and pedestrians in real time, the system helps prevent accidents caused by driver fatigue and delayed reaction to pedestrians. The system provides a cost-effective and efficient solution that can be further developed for integration into modern vehicles.

Furthermore, the proposed system highlights the potential of combining multiple computer vision techniques into a single integrated solution. This approach not only enhances system efficiency but also improves overall reliability. Hence, the DROWZISHIELD system serves as a strong

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foundation for future intelligent driver assistance systems.

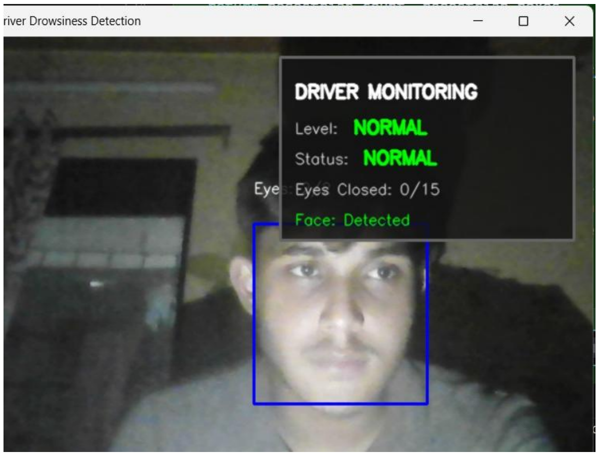

Fig. 5. Driver monitoring system showing normal condition with eyes open.

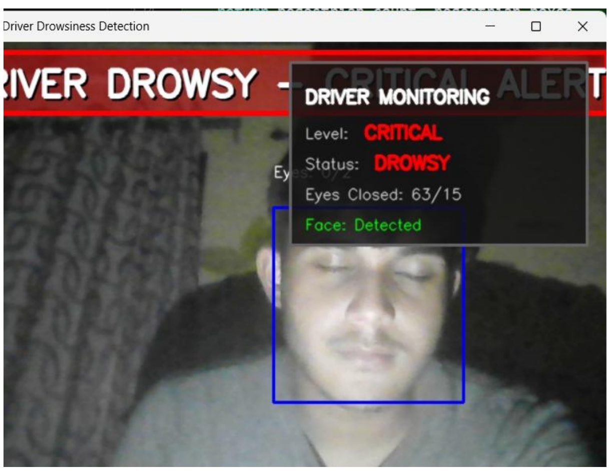

Fig. 6. Driver drowsiness detection with alert triggered when eyes are closed.

IX. FUTURE WORK

The system can be further enhanced by integrating additional safety features. Automatic braking systems can be connected to the detection module so that the vehicle can automatically slow down when danger is detected. Lane detection and collision prediction can also be implemented to improve driving safety. Infrared cameras may be used for better monitoring during night driving. The system can also be deployed on embedded platforms such as Raspberry Pi or NVIDIA Jetson for real vehicle implementation. Integration with smart dashboards and IoT systems can enable remote monitoring and data analysis.

Furthermore, the proposed system highlights the potential of combining multiple computer vision techniques into a single integrated solution. This approach not only enhances system efficiency but also improves overall reliability. Hence, the DROWZISHIELD system serves as a strong foundation for future intelligent driver assistance systems.

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