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Awake Assist Project Report

Title: Awake Assist.

Abstract

Drowsiness is a leading cause of road accidents, which often result in traffic congestion, property damage, and even loss of life. This project introduces a real-time, non-intrusive driver drowsiness detection system aimed at enhancing road safety and minimizing traffic disruptions. The system leverages an advanced object detection model to analyze a driver's facial expressions, focusing on identifying key indicators of drowsiness such as yawning, eye closure, and head movement. The model classifies these behaviors into three categories: normal, yawning, and sleep.

Once the system detects signs of drowsiness, particularly when the driver is falling asleep, an integrated alert mechanism is activated to immediately wake the driver. This warning system plays a critical role in preventing accidents caused by driver drowsiness , ensuring that drivers remain alert and attentive.

The proposed solution is designed for real-time performance, capable of running efficiently in various lighting conditions and environments. By reducing accidents related to drowsiness, this system not only improves road safety but also supports the broader goals of reducing traffic congestion and contributing to the efficiency of transportation networks.

Introduction

Road accidents are a leading cause of fatalities which increase traffic congestion worldwide, and driver drowsiness is one of the major contributors to these accidents. Drowsiness reduces drivers' alertness, reaction time, and decision-making capabilities, significantly increasing the risk of collisions.

To address this issue, the development of advanced, non-intrusive detection systems has become a crucial step toward enhancing road safety. This project proposes a real-time driver drowsiness detection system that uses an object detection model to continuously monitor drivers' facial expressions. By classifying behaviours into three categories—normal, yawning, and sleep—the system can accurately detect signs of fatigue like yawning and sleep. When sleep is detected, an integrated alert feature will instantly wake the driver, thereby reducing the risk of accidents and improving traffic flow.

The proposed solution not only enhances driver safety but also contributes to the broader goals of Saudi Vision 2030, which focuses on improving road infrastructure and reducing traffic congestion to promote more efficient transportation networks.

Literature Review:

Driver drowsiness detection has transitioned from intrusive physiological monitoring techniques, to non-intrusive computer vision-based approaches. The shift to non-intrusive methods is driven by the need for real-time performance without physically attaching sensors to drivers. Object detection models, such as YOLO (You Only Look Once), have proven to be highly effective for this task, enabling real-time monitoring of facial expressions like yawning, eye closure, and head movements, which are key indicators of drowsiness.

Recent studies have demonstrated the success of deep learning models in classifying driver states—alert, yawning, or asleep—by analysing facial features. These systems are designed to detect subtle changes in facial expressions that indicate drowsiness. Models like YOLOv8 are particularly well-suited for this application due to their fast-processing speed, enabling real-time detection, although challenges remain in ensuring accuracy under different lighting conditions and with occlusions such as sunglasses.

Additionally, The integration of alert systems to wake drivers when sleep is detected is essential for the system's effectiveness and it may serve not only the driver to be awake, but also other people to prevent accidents that cause traffic obstruction .

Data Description and Structure :

The dataset is images consists of drivers' states, classified into three categories:

1. Normal (248 images)
2. Yawning (255 images)
3. Sleep (375 images)

Datasets were sourced from:

1. Kaggle. 2. Roboflow.

Data was collected with a focus on diversity:

- Time of Day: Captured images in both morning and night conditions.
- Gender Representation: Included images of both women and men.
- Driver's Appearance: Whether drivers are wearing glasses to account for variations in appearance.

The dataset is divided into:

- Training Set: 85% (approximately 1,695 images)
- Validation Set: 7% (approximately 149 images)
- Test Set: 8% (approximately 150 images)

Pre-processing and augmentation techniques applied include:

- Auto-Adjust Contrast - Grayscale Conversion
- Resizing - Brightness Adjustment
- Noise Addition - 90° Rotation

Methodology

1. Problem Selection: detecting driver drowsiness, specifically identifying instances of drowsiness or yawning while driving.

2. Data Collection

Data was collected from a variety of sources.

3. The collected data underwent pre-processing using Roboflow.

4. Model Training

The pre-processed data was uploaded to a training environment where the YOLOv8 model was employed. The training process included:

- Model Configuration: Setting parameters such as epochs.

- Training: Running the model on the dataset to learn the features associated with driver states.

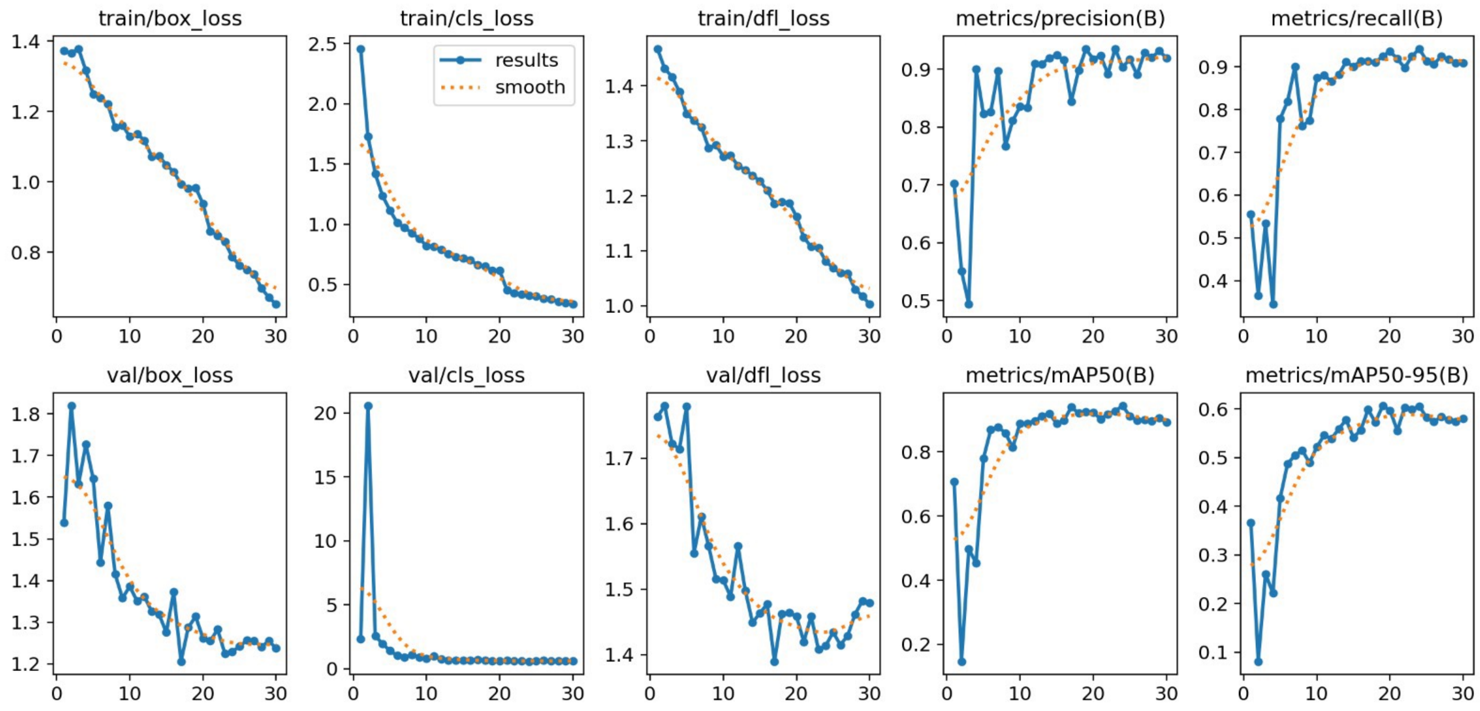
- Evaluation: Assessing the model's performance using metrics like precision, recall, and F1-score to ensure accuracy in detection.

5. Alerts Method: An alert system was defined and integrated into the model, providing (Auditory Alerts).

6. Deployment: The model was deployed using Streamlit, allowing for trying the model.

Results:

The project's findings reveal that the proposed real-time driver drowsiness detection system effectively monitors facial expressions to classify driver states into normal, yawning, and sleep categories.



Through the use of YOLOv8 object detection, the system achieved high accuracy in detecting driver drowsiness while descending loss functions for the current dataset in a specific period of time, with timely activation of the integrated alert mechanism when sleep was identified. The model demonstrated robustness in real-time performance, maintaining accuracy across varying lighting conditions and driver head positions.

Discussion:

When compared to previous research, the project aligns with findings from similar studies that emphasize the efficiency of deep learning models in non-intrusive drowsiness detection. However, this solution stands out by optimizing real-time processing, even in more challenging environmental conditions. The inclusion of an alert feature further enhances safety, effectively preventing drowsiness-related accidents. This contribution is significant, as it not only addresses a critical road safety issue but also aligns with Saudi Vision 2030's goals of enhancing transportation safety and efficiency.

Conclusion and Future Work

Conclusion:

The project developed a real-time driver drowsiness detection system using YOLOv8 to classify driver states as normal, yawning, or asleep. The system effectively detects drowsiness and triggers an alert when sleep is detected, significantly improving road safety and supporting Saudi Vision 2030's goals for transportation. The system's practical applications include use in commercial and personal vehicles, reducing the risk of accidents caused by drowsy driving.

Future Work:

Future improvements include adding a feature to interact with drivers when yawning is detected, as signs or lights encouraging focus before falling asleep. Additional safety features such as detecting phone usage and seatbelt compliance will be integrated. An automatic braking system is also proposed to stop the vehicle when sleep is detected. Further model optimizations will aim to enhance performance.

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