Drowsiness Detection in Drivers

Presented by -

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Problem Statement

- Drowsy driving is a major cause of road accidents, leading to injuries and fatalities.
- Traditional detection methods like self-reporting and vehicle-based monitoring are unreliable.
- There is a need for an **automated, real-time system** to detect driver drowsiness
- The system should analyze **facial cues** such as **mouth openness, yawning, and eye closure** to determine drowsiness.
- A deep learning-based approach using **YOLO11** can effectively detect and classify driver drowsiness.

Proposed Solution

- **Our Approach:** We've built a smart drowsiness detection system using YOLO11, designed to recognize signs of fatigue by detecting closed eyes and yawning.
- **Real-Time Monitoring:** The system continuously analyzes the driver's face and instantly triggers an alert if drowsiness is detected.
- **Easy Integration:** This model can be deployed in car dashboards or even smart vehicle systems for enhanced road safety.
- We trained two YOLO models—one to detect whether the eyes and mouth are open or closed, and another to detect yawning. By combining both, we get a more accurate drowsiness detection system.

Model Used & Approach

❑ Model Used : YOLO11n

- **Closed Eyes Detection:** The system keeps an eye on the driver's eyelids. If the eyes stay closed for more than 3 seconds, it assumes the driver might be dozing off and triggers a warning with an alert sound. The timer resets once the driver opens their eyes again.

- **Yawning Detection:** If the driver yawns, the system detects it and plays a distinct beep sound as a reminder that they might be getting tired.

- **Drowsiness Classification:** A separate model continuously analyzes the driver's face. If it explicitly detects drowsiness, it triggers a critical alert with a long, high-frequency beep to ensure the driver is aware.

- **Extreme Fatigue Detection**: If the driver has both closed eyes and an open mouth for a prolonged period, the system treats this as a sign of severe fatigue or micro-sleep. In this case, an urgent alert is activated with a loud, high-pitched sound to help wake them up.

Datasets Used

1. Yawning Dataset (Link)

- Contains labeled images of drivers with open and closed mouths.
- Helps detect **yawning**, a key indicator of drowsiness.

2. Eye-Mouth Dataset (Link)

- Includes images of eyes and mouths in different states (open or closed).
- Used to analyze **eye closure and mouth movement** for drowsiness detection.

Both datasets were preprocessed and used to train **YOLO11** for real-time drowsiness detection. 🚗 💡

Training

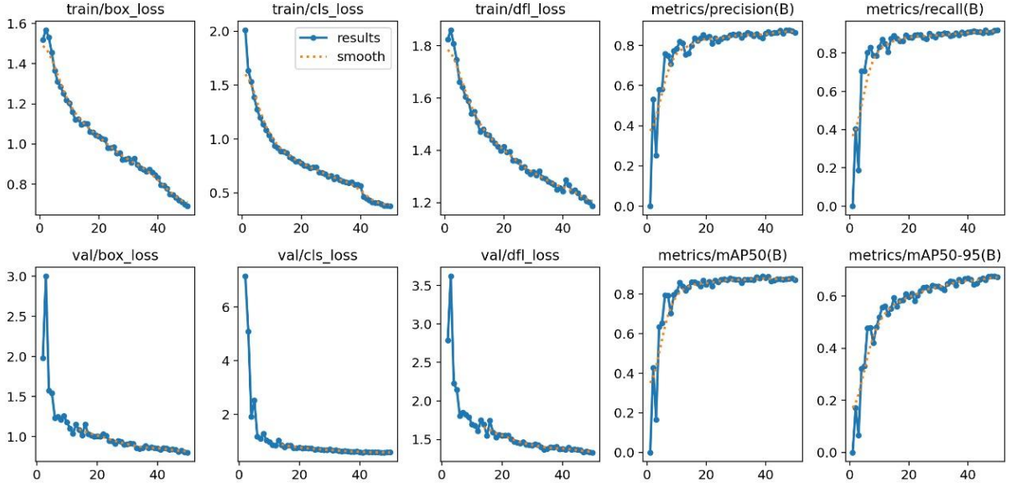
- YOLO11 was trained for **50 epochs** on labeled datasets.

- **System Specifications** – NVIDIA GeForce RTX 4090,
  CUDA Version : 12.2

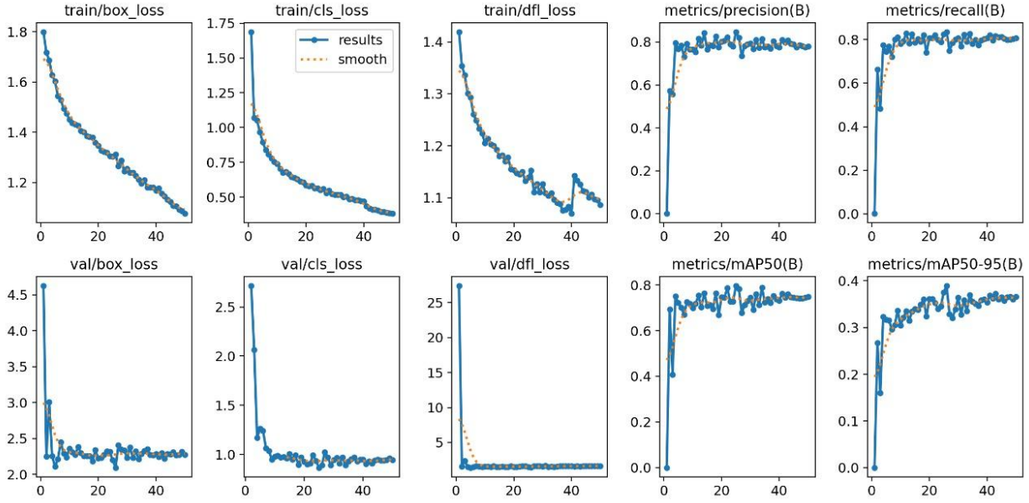
- **Accuracy – 90.74%**

Results

Eye Mouth detection model:



Yawning detection model:



Challenges and Improvements

- **Real-time Processing:** The model must run efficiently without delays. *(Solution: Optimize YOLO11 for faster inference.)*
- **Variability in Facial Features:** Different face structures can impact accuracy. *(Solution: Train on a more diverse dataset.)*
- **Lighting Conditions:** Poor or excessive lighting affects detection. *(Solution: Use data augmentation and adaptive brightness adjustments.)*
- **Class Imbalance:** Drowsy instances are fewer, leading to biased training. *(Solution: Balance dataset through augmentation and weighted loss functions.)*
- **False Positives & Negatives:** Misclassifications can reduce system reliability. *(Solution: Fine-tune detection thresholds dynamically.)*
- **System Integration:** Needs seamless connectivity with vehicle alerts. *(Solution: Integrate with car warning systems for real-time alerts.)*

Potential Impacts

- **Reduced Road Accidents:** Early detection of drowsiness can help prevent crashes.
- **Enhanced Driver Safety:** Alerts ensure drivers stay aware and take necessary breaks.
- **Real-time Monitoring:** Provides continuous, automated drowsiness detection without manual intervention.
- **Improved Road Safety Regulations:** Can support enforcement of fatigue management laws.
- **Technological Advancement:** Encourages further AI-driven safety innovations in transportation.
- **Lower Economic Losses:** Reducing accidents helps minimize medical, insurance, and vehicle repair costs.

Conclusion

• The Driver Drowsiness Detection System using YOLO11 accurately detects drowsiness based on yawning, mouth openness, and eye closure.
• Real-time detection can help prevent accidents by providing timely alerts to drivers.
• Challenges like lighting conditions, class imbalance, and false detections can be improved with better datasets, adaptive algorithms, and model optimization.
• This project has significant real-world applications in road safety, fleet management, and AI-driven transportation systems.
• Future improvements can include enhanced dataset diversity, lightweight model optimization, and integration with vehicle alert systems to further improve driver safety. 🚗 💡