Kalinga Institute of Industrial Technology

KALINGA INSTITUTE
OF INDUSTRIAL TECHNOLOGY
Deemed to be University U/S 3 of the UGC Act, 1956

CVPR Mini Project Presentation (2025-2026)

Topic - Driver Drowsiness Detection System
GROUP - 10

Submitted By:
Prithankur Dasgupta- 2330250
Rishika Sarma- 2330253
Sayam Mondal - 2330263
Shreya Shree-2330266

Objective:

Develop a real-time driver drowsiness detection system using a hybrid CNN-based approach to monitor eye states and prevent road accidents through early fatigue detection.

- **Eye State Classification** - Accurately distinguishes between open and closed eyes using trained CNN models.
- **Computational Efficiency -** Minimize computational cost to enable real-time performance on standard hardware.
- **Driver Alert System -** Implement immediate notification mechanism when drowsiness is detected.

Dataset used: MRL Eye Dataset

Dataset Source: MRL Eye Dataset (via Kaggle) – https://www.kaggle.com/datasets/imadeddinedjerarda/mrl-eye-dataset/data

- Contains labeled open and closed eye images from different people, lighting conditions, and glasses types.
- Preprocessed into 224×224 grayscale images for training.
- The classification (awake/sleepy) aligns directly with the driver-drowsiness detection goal of our system.
- 2 built-in OpenCV files used for face and eye detection:
    1. haarcascade_frontalface.xml - Detects face of a person
    2. haarcascade_eye.xml - Detects eyes

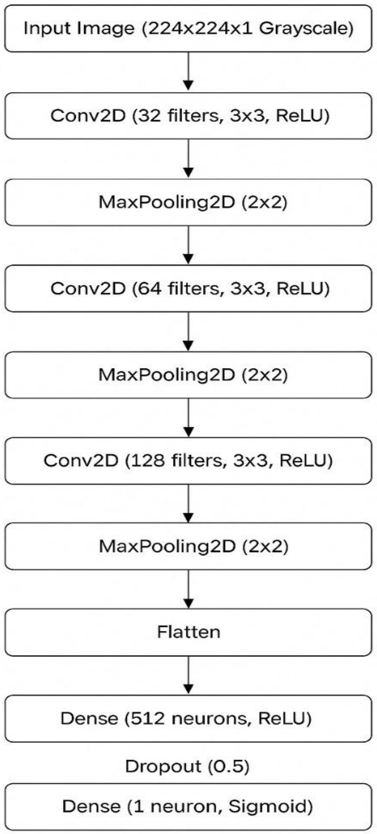
Methodology

Key Optimizations

- ImageDataGenerator for efficient batch loading
- Grayscale processing to reduce memory footprint
- Shallow CNN design for fast inference
- Haar cascades for robust eye detection

Network Layers

Conv2D → Max Pooling (×3) → Flatten → Dense (512, ReLU) → Dropout (0.5) → Output (Sigmoid)

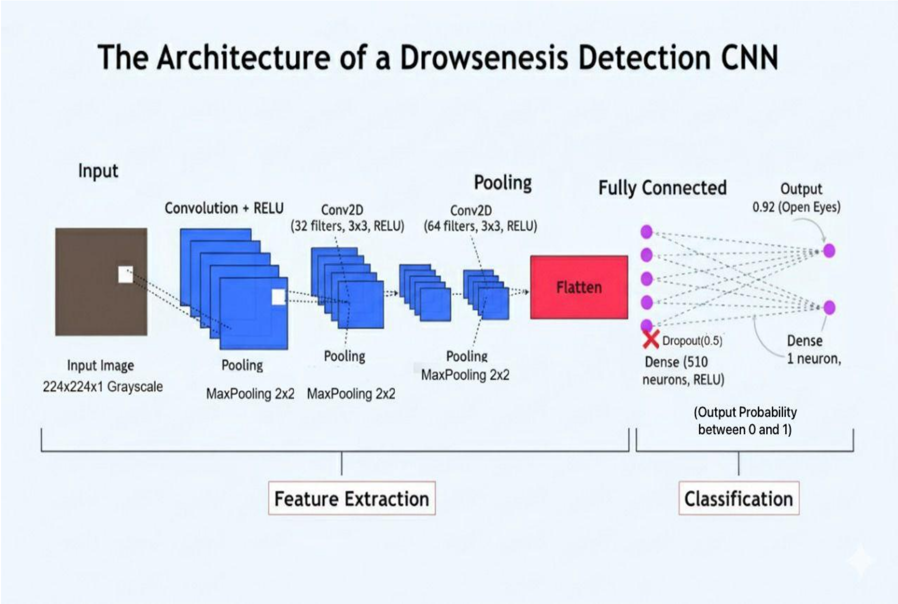


Model Architecture

Architecture of Drowsiness Detection CNN

- **Input:** 224×224×1 grayscale eye image.
- **Feature Extraction:**
  - **Conv2D layers (3×3, ReLU):** Extract eye features.
  - **Max Pooling (2×2):** Reduces size and retains key details.
  - Two convolution–pooling blocks with 32 and 64 filters.
- **Flatten:** Converts feature maps into a 1D vector.
- **Fully Connected Layers:**
  - Dense (510 neurons, ReLU) + Dropout(0.5) to prevent overfitting.
- **Output Layer:**
  - Single neuron with Sigmoid activation gives probability (0–1).
  - Example: 0.92 → Open Eyes, 0.08 → Closed Eyes.

Combines feature extraction and classification for real-time drowsiness detection.



Model Summary:

- Model built using TensorFlow/Keras Sequential API.
- Total Parameters: ~44.4 million
- Trainable Parameters: 44,396,033
- Non-trainable Parameters: 0
- Layers used: Conv2D, MaxPooling2D, Flatten, Dense, Dropout

Model: "sequential"

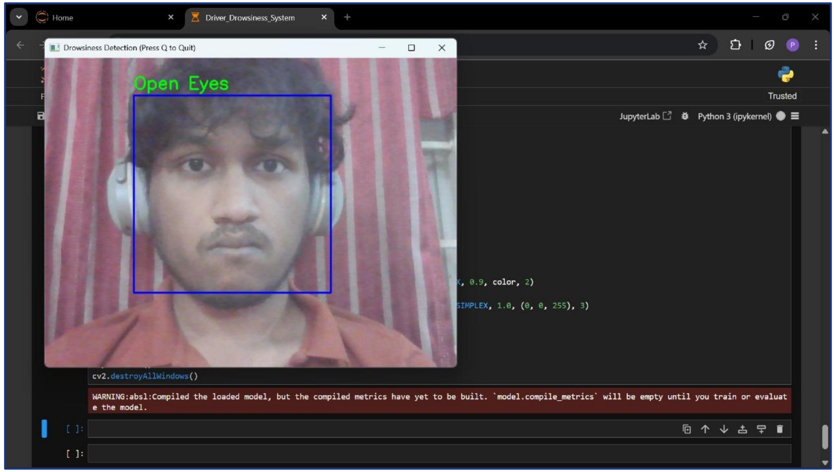
Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 222, 222, 32)	320
max_pooling2d (MaxPooling2D)	(None, 111, 111, 32)	0
conv2d_1 (Conv2D)	(None, 109, 109, 64)	18,496
max_pooling2d_1 (MaxPooling2D)	(None, 54, 54, 64)	0
conv2d_2 (Conv2D)	(None, 52, 52, 128)	73,856
max_pooling2d_2 (MaxPooling2D)	(None, 26, 26, 128)	0
flatten (Flatten)	(None, 86528)	0
dense (Dense)	(None, 512)	44,302,848
dropout (Dropout)	(None, 512)	0
dense_1 (Dense)	(None, 1)	513

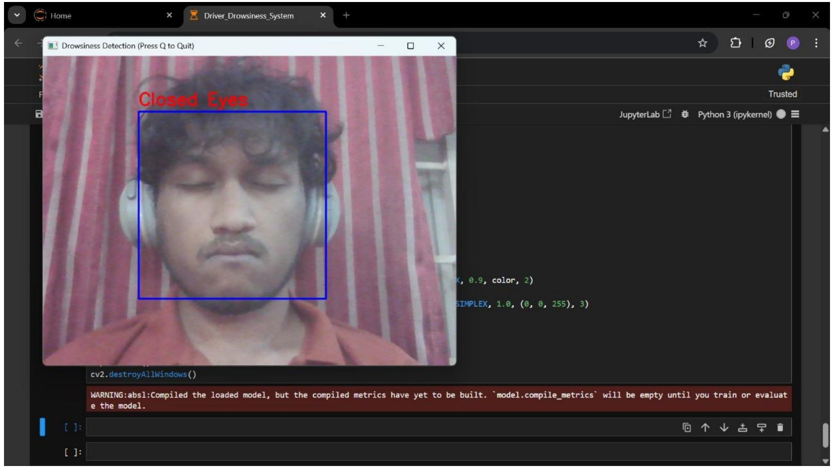
Total params: 44,396,033 (169.36 MB)

Trainable params: 44,396,033 (169.36 MB)

Non-trainable params: 0 (0.00 B)

Detection Results:



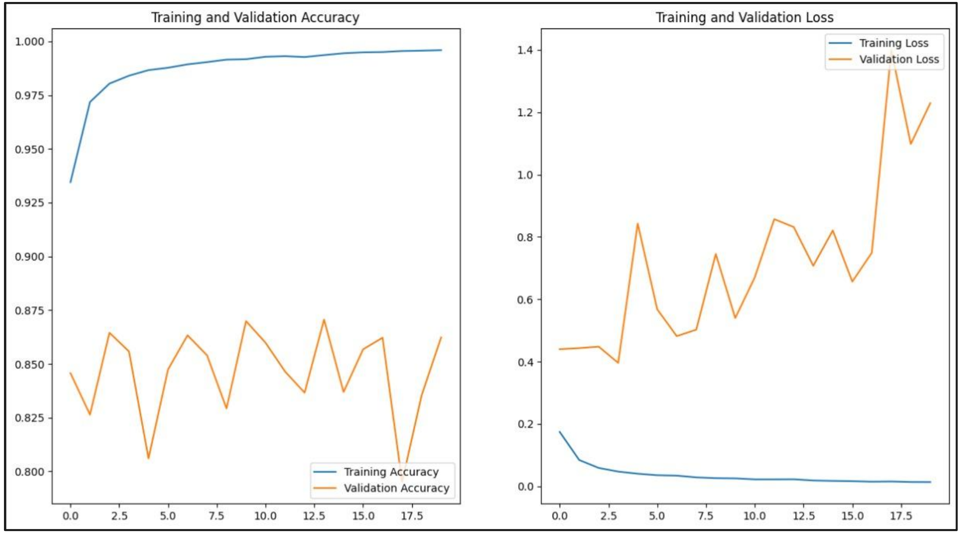


Left image (open eyes):
Detected: Open Eyes (Alert State)
The CNN correctly identifies the driver's eyes as *open*, indicating that the driver is alert and active.

Right image (closed eyes):
Detected: Closed Eyes (Drowsy State)
The CNN detects *closed eyes*, signaling potential drowsiness and triggering a safety alert.

Training Performance

99% Training Accuracy Exceptional learning performance on training dataset	85% Validation Accuracy Reliable performance on unseen data with room for improvement	169 Model Size Lightweight architecture with 44M parameters for real-time deployment



Key Insights

- The system achieves strong training accuracy with minor overfitting evident in validation loss. Real-time implementation successfully detects drowsiness by monitoring consecutive frame classifications with immediate alert triggering.

Conclusion

The developed real-time driver drowsiness detection system effectively identifies eye states using a lightweight CNN model and Haar cascades, ensuring fast and reliable performance.

Highlights:

- Achieved ~99% training and ~85% validation accuracy.
- Optimized for memory efficiency using grayscale images and batch loading.
- Suitable for real-time implementation on moderate hardware.

Future Scope:

- Enhance generalization with data augmentation.
- Integrate facial landmarks for greater accuracy.

Reference

1. https://www.kaggle.com/datasets/imadeddinedjerarda/mrl-eye-dataset/data
2. https://www.youtube.com/watch?v=qwUIFKi4V48
3. https://www.youtube.com/watch?v=Auy-t_zNORI
4. https://www.youtube.com/watch?v=mTVf7BN7S8w
5. https://drive.google.com/drive/folders/1pVicYluTIChHbVZkKzqymXIt2jiMQiSd