Semantic Segmentation on Indian Driving Dataset (IDD)

FMML Capstone Project, IIITH

Presented by: Sadiya Maheen Siddiqui (HUB20240169)

Understanding the Problem Context

Unstructured Environment

Indian roads lack uniform lanes and rules, posing segmentation challenges.

Varied Traffic Behaviour

Diverse vehicle types and unpredictable movement patterns.

Inconsistent Infrastructure

Mixed road quality and inconsistent signage impact model robustness.

Project Objective

Modeling

Develop a segmentation model adapted specifically for Indian roads.

Evaluation

Optimize performance using Mean Intersection over Union (mIoU).

Training Techniques

Implement checkpointing and fine-tuning to enhance model stability.

Dataset Overview

Source

Indian Driving Dataset (IDD) Part I & II, 20,000 samples.

Resolution

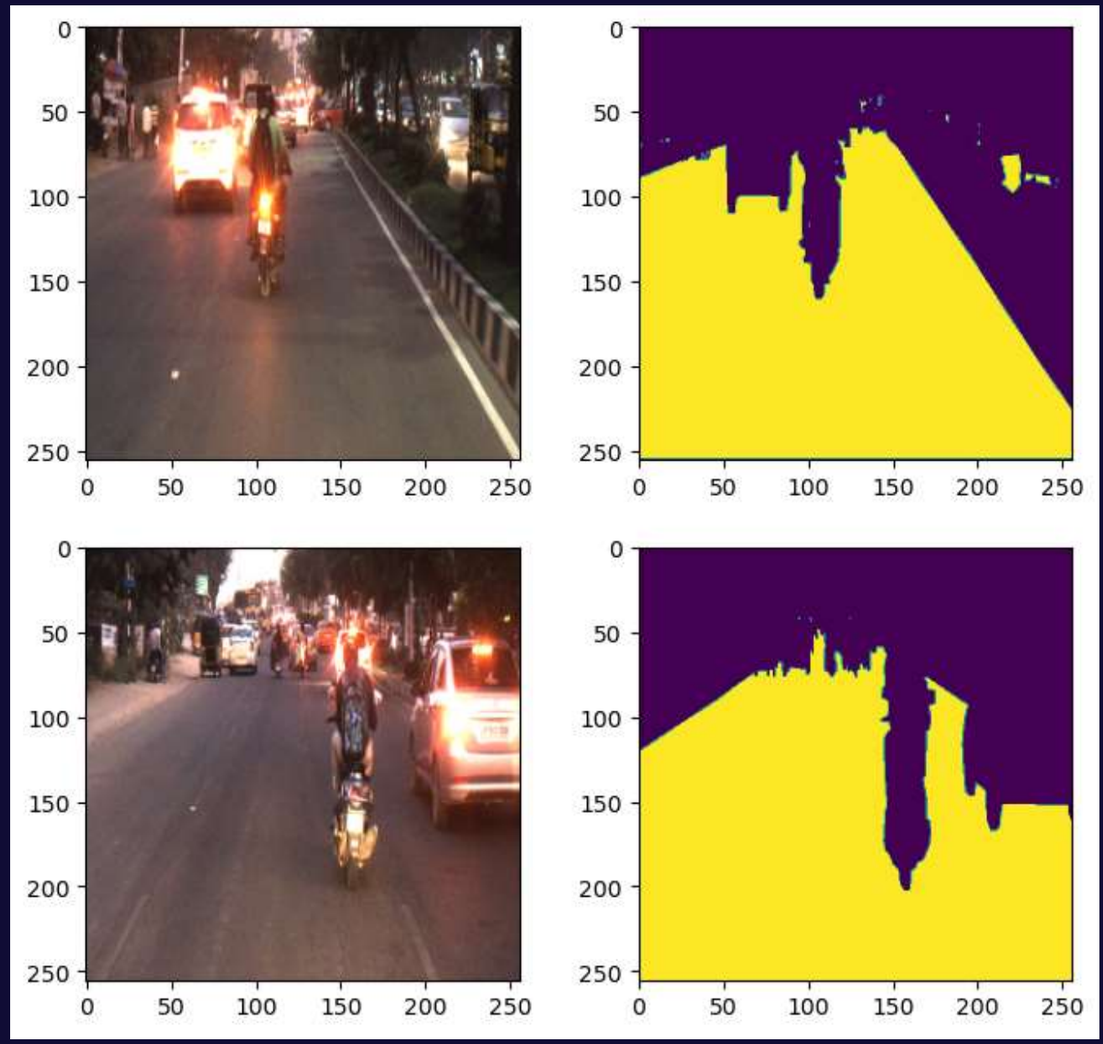
Original: 1280×720, resized to 256×256 for training efficiency.

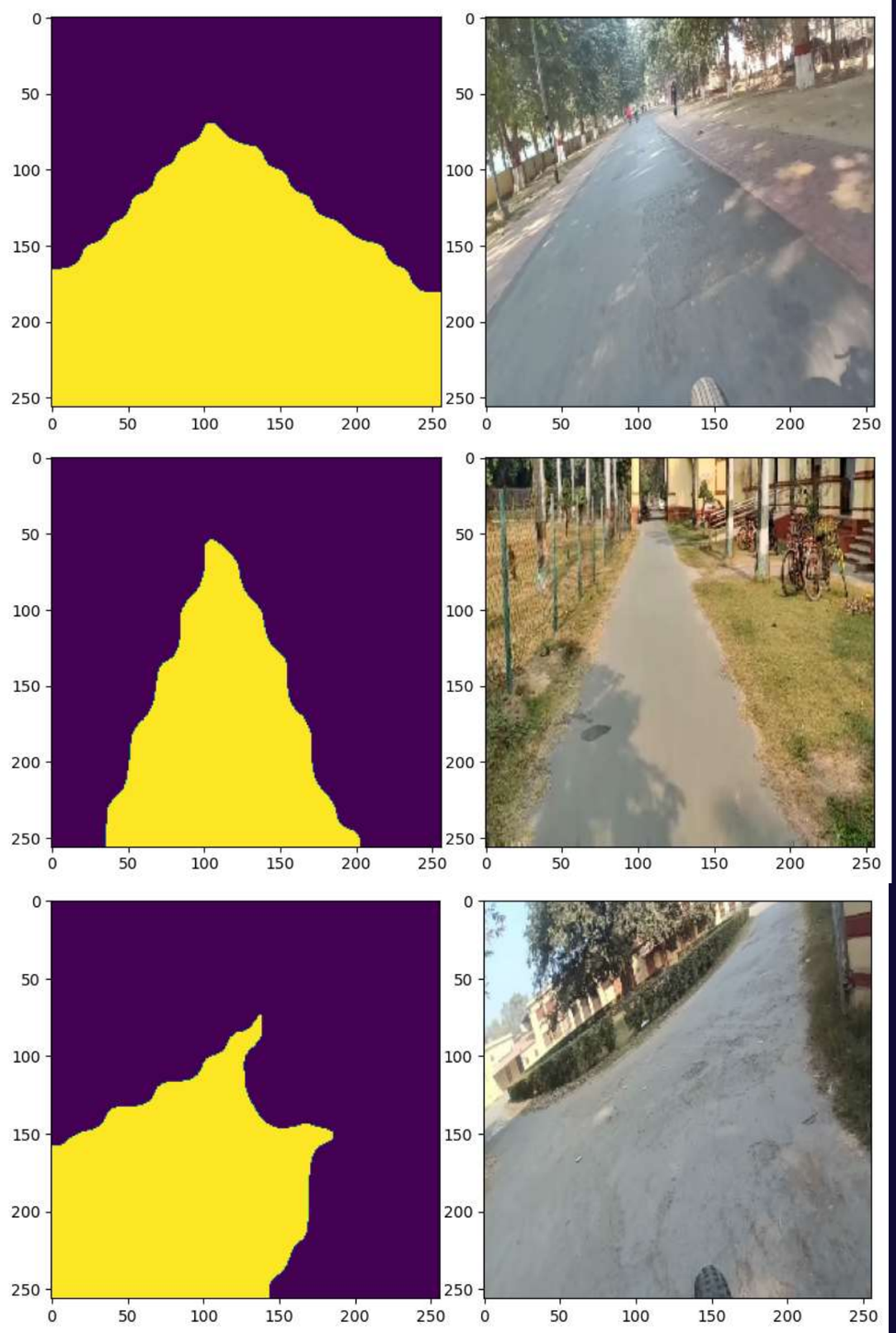
Labels

26 detailed Level 3 semantic classes plus one miscellaneous class.

Train/Validation

85% training data, 15% validation split.





Methodology

1

Preprocessing

Resizing and data augmentations like flipping, rotation, and colour jitter.

2

Model Architecture

DeepLabV3+ with MobileNetV2 backbone, optimising accuracy and efficiency.

3

Training Setup

Adam optimizer, 10 epochs, batch size 32, cross-entropy loss with masking.

Results and Evaluation

0.852

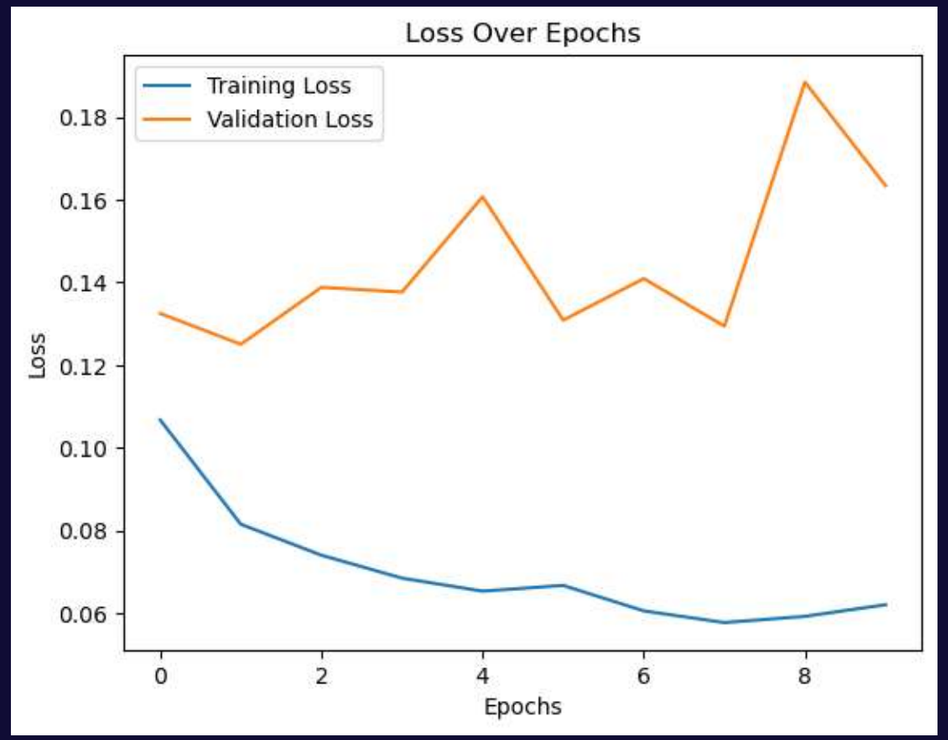
Best mIoU

Achieved at Epoch 8, representing high segmentation accuracy.

8

Epoch

Epoch at which best validation performance was recorded.



Challenges Encountered

Resolution Trade-off

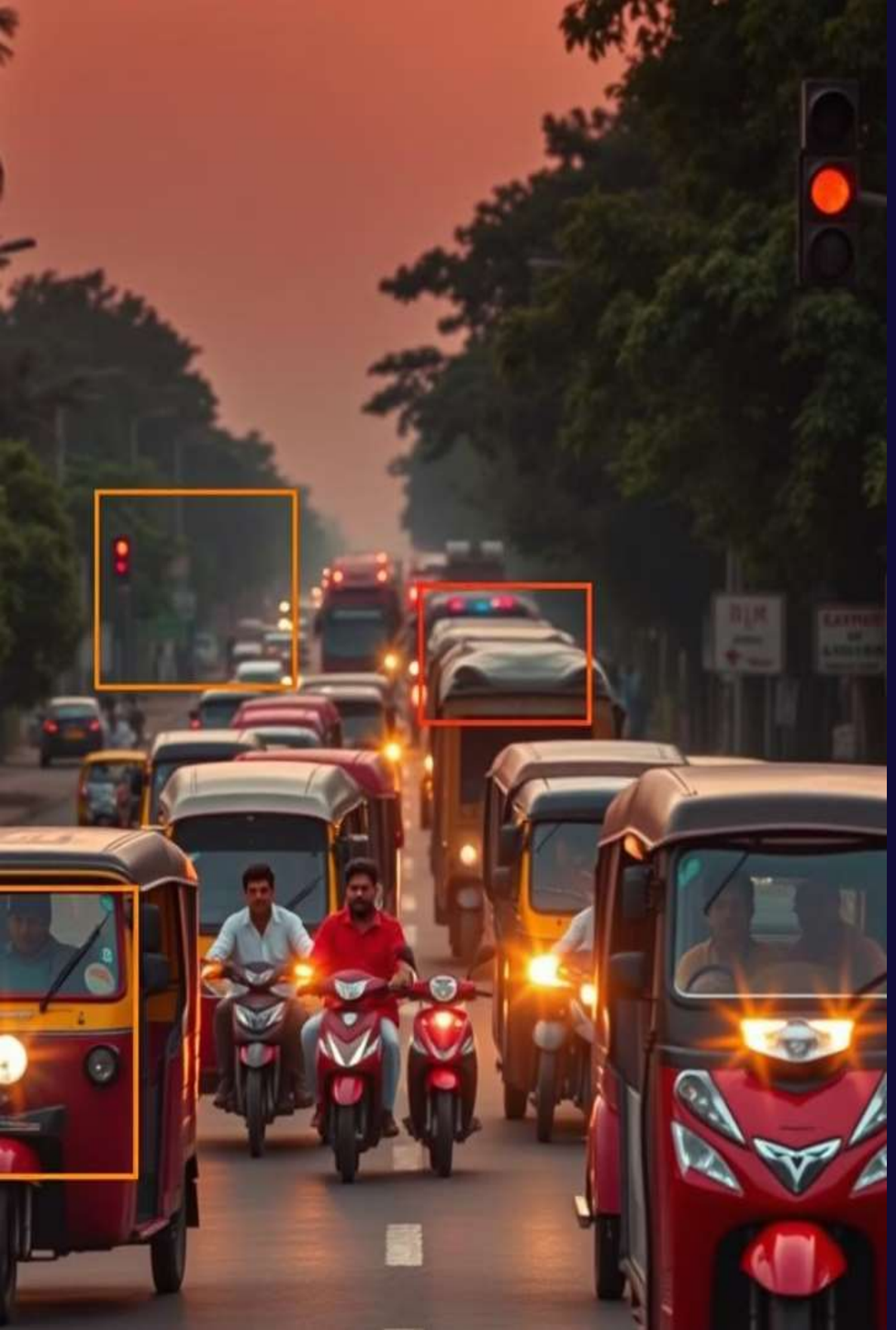
256 × 256 resizing balances speed with segmentation detail, limiting precision.

Overfitting

Minor overfitting observed post Epoch 8, affecting generalization.

Class Imbalance

Lower segmentation accuracy for rare classes due to insufficient samples.



Future Directions

Higher Resolution Training

Scaling input size to 512 × 512 or full 1280 × 720 for better detail.

Transformer Architectures

Testing SegFormer and Mask2Former for improved segmentation accuracy.

Domain Adaptation

Leveraging external datasets like Cityscapes and BDD100K to enhance robustness.

Conclusion and Takeaways

Robust Model Performance

DeepLabV3+ with lightweight backbone excelled on IDD data.

Modular Pipeline

Flexible for future improvements and experiments.

Real-World Impact

Supports advancement of autonomous driving tech tailored to Indian context.