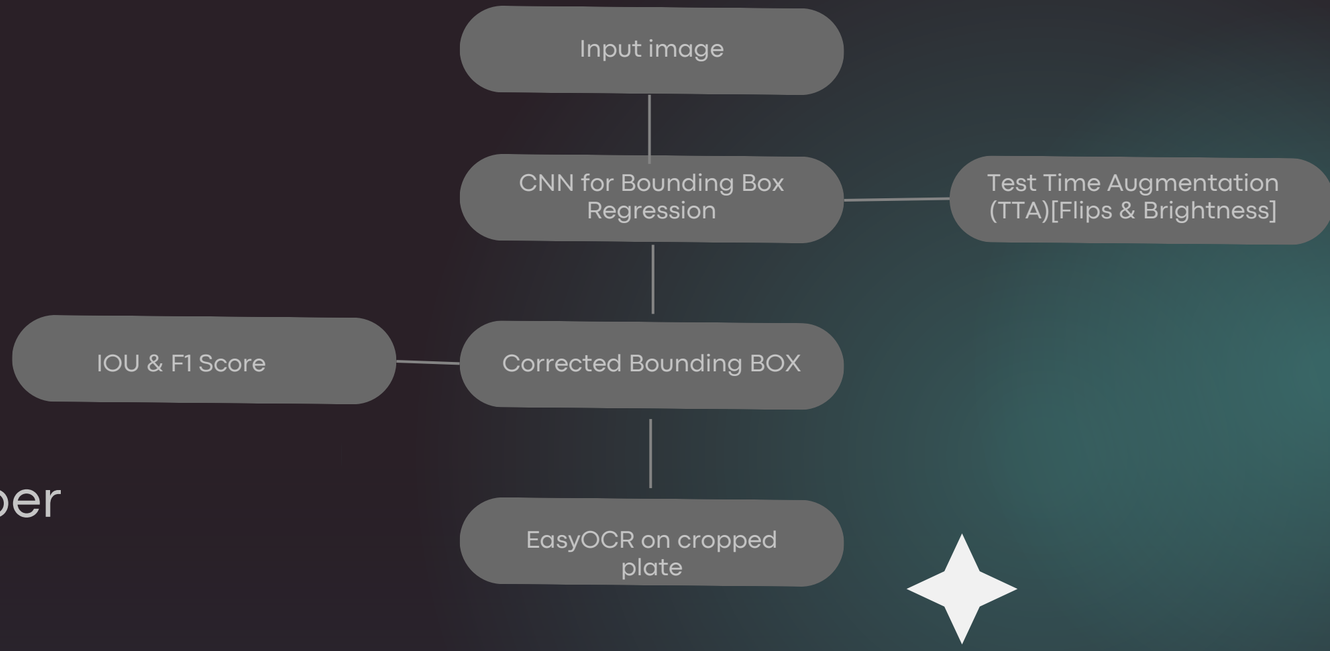
Vehicle Number plate detection and recognition using custom CNN and EasyOCR

Deep Learning

Presentation

PROBLEM STATEMENT

This project aims to develop an automated toll collection system by detecting and recognizing vehicle number plates using a custom CNN model and OCR, replacing traditional toll plazas or FASTag systems. The toll is dynamically charged based on the distance travelled.



DATASET DESCRIPTION

- Type: Number plate images + negative samples
- Source: 5 Kaggle datasets (Pascal VOC & YOLO format)
- Split: 80% Train, 10% Val, 10% Test
- Size: ~3.5 GB

- Resize & pad to maintain aspect ratio.
- OCR pipeline prep:
  - Convert to grayscale & Canny edge detection

Total: ~9.6k images
(8k used after cleaning)

Resolution: 416x416 (resized + padded)

CNN MODEL ARCHITECTURE

The 2 main areas of architecture:

- 5 Conv Layers + BatchNorm2D
- ReLU Activations + Dropout(0.3) before Dense
- Fully Connected:
  - Flatten → Linear(512) → Linear(4)
- Loss Function: SmoothL1Loss
- Scheduler: StepLR
- Output: (x_min, y_min, x_max, y_max)

Adam Optimizer

SmoothL1Loss

Epochs: 10

Learning Rate Scheduler: ReduceLROnPlateau

Metric: IoU

Early Stopping

Model Input: (3, 224, 224)
Output: Normalized bounding box
52.1M+ Parameters

Number Plate Detection

Deep Learning Presentation

VISUALIZATIOS

Performance Visualizations

Train VS Val Loss Curve

Validation IoU Curve

- Sample Predictions:
  - Ground Truth Box: Green
  - Predicted Box: Red

Confusion matrix

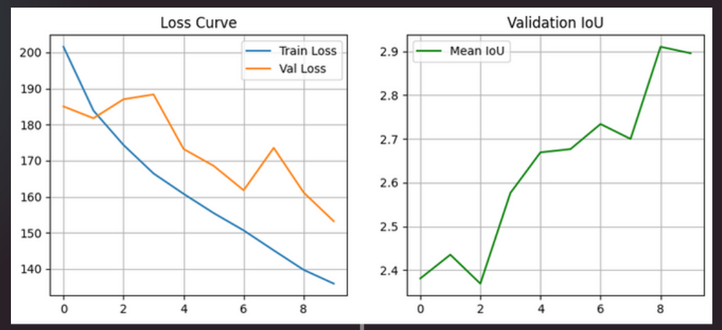
F1 score

- **Confusion Matrix:**

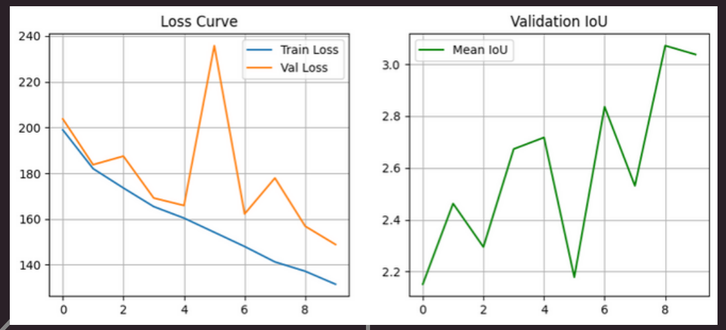
[[0(TN) 0(FP)]
[1492(FN) 382(TP)]]

- **F1 Score:** 0.3387
- **Recall:** 0.2038

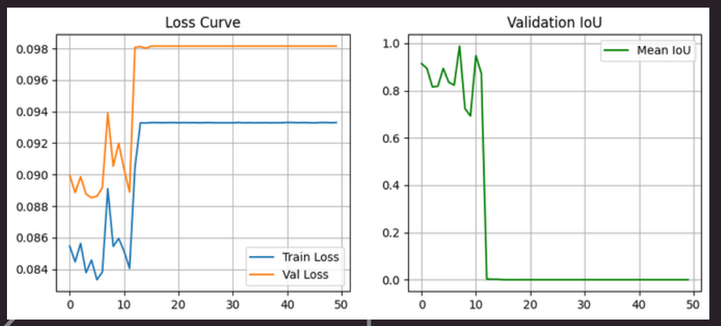
IMPROVEMENT ANALYSIS



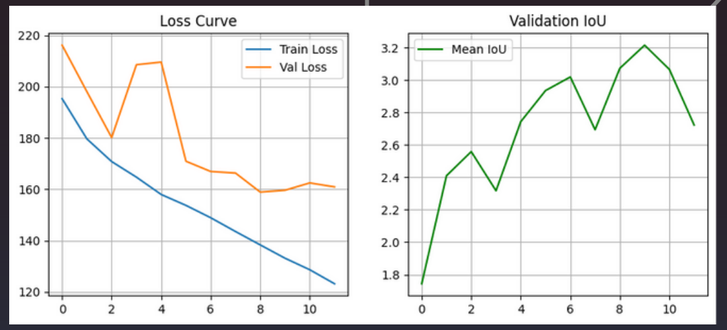
Graph 1



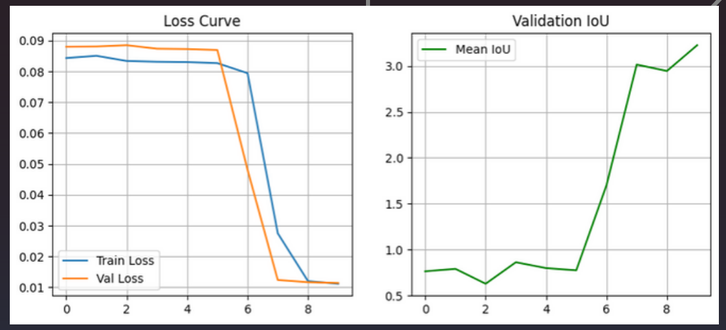
Graph 3



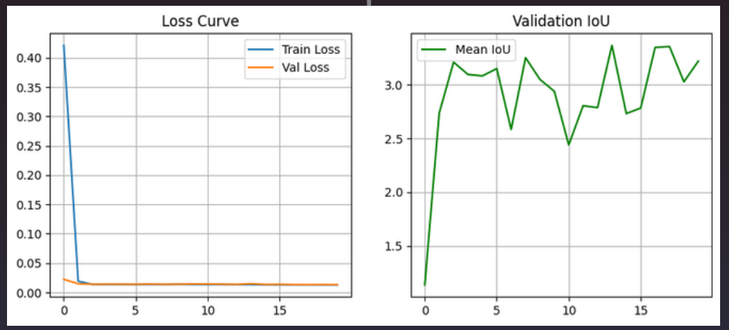
Graph 5



Graph 2

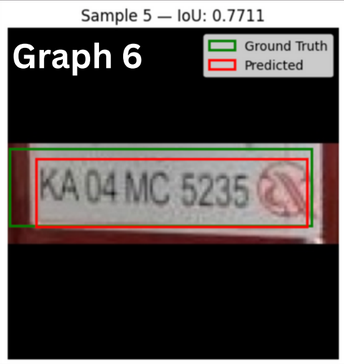


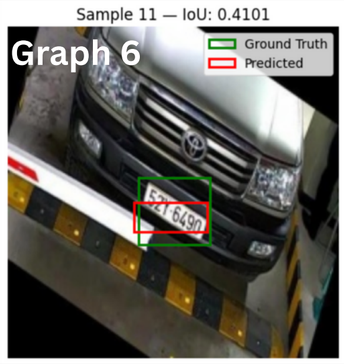
Graph 4

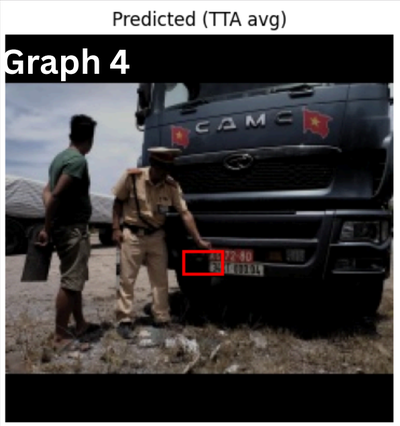


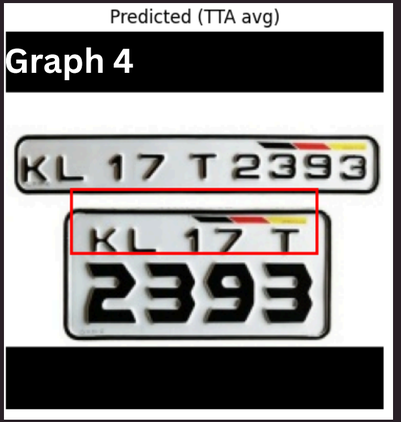
Graph 6

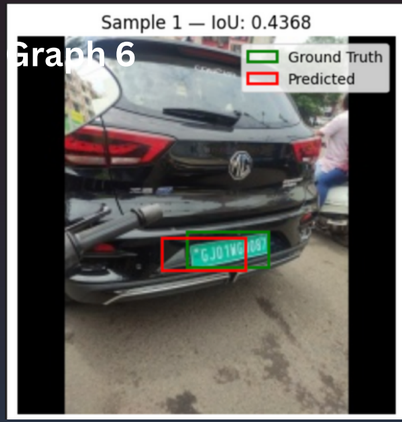
VISUALIZATIONS

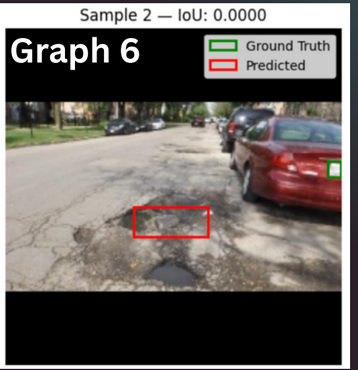


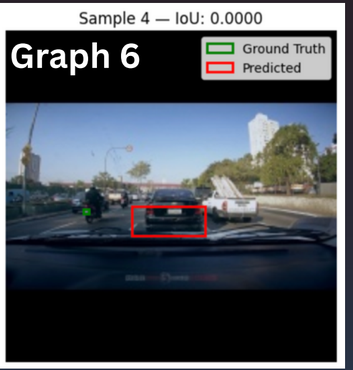












RECOGNITION

- Detect Plate: Use CNN to predict bounding box (normalized → pixel).
- Crop Plate: Extract the plate region from the image using the predicted box.
- Read Text: Use EasyOCR to recognize text from the cropped image.