AUTOMATED TRAFFIC VIOLATION DETECTION SYSTEM

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OBJECTIVE

- To create an system capable of detecting traffic violations by identifying traffic light signals, extracting license plate information, and flagging offending vehicles using OCR (Optical Character Recognition) technology.

  - Detect traffic light colors to determine signal status (Red, Yellow, Green).
  - Identify vehicles crossing the white line during a red light.
  - Extract license plates of violating vehicles using image preprocessing.
  - Use OCR to read and store license plate details.
  - Display fined license plate numbers on the video feed.

IMPLEMENTATION DETAILS

Traffic Light Detection

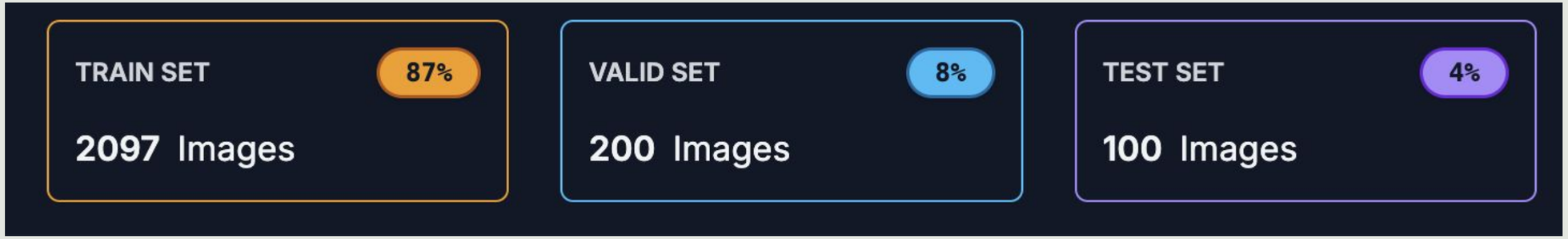
- Function: detect_traffic_light_color
- Process:
  - Extracts the Region of Interest (ROI) where the traffic light is located.
  - Converts the ROI to HSV color space for robust color detection.
  - Detects Red, Yellow, or Green light and overlays the corresponding signal status on the frame.

Dataset

RoboFlow dataset is used for Traffic Light Detection.

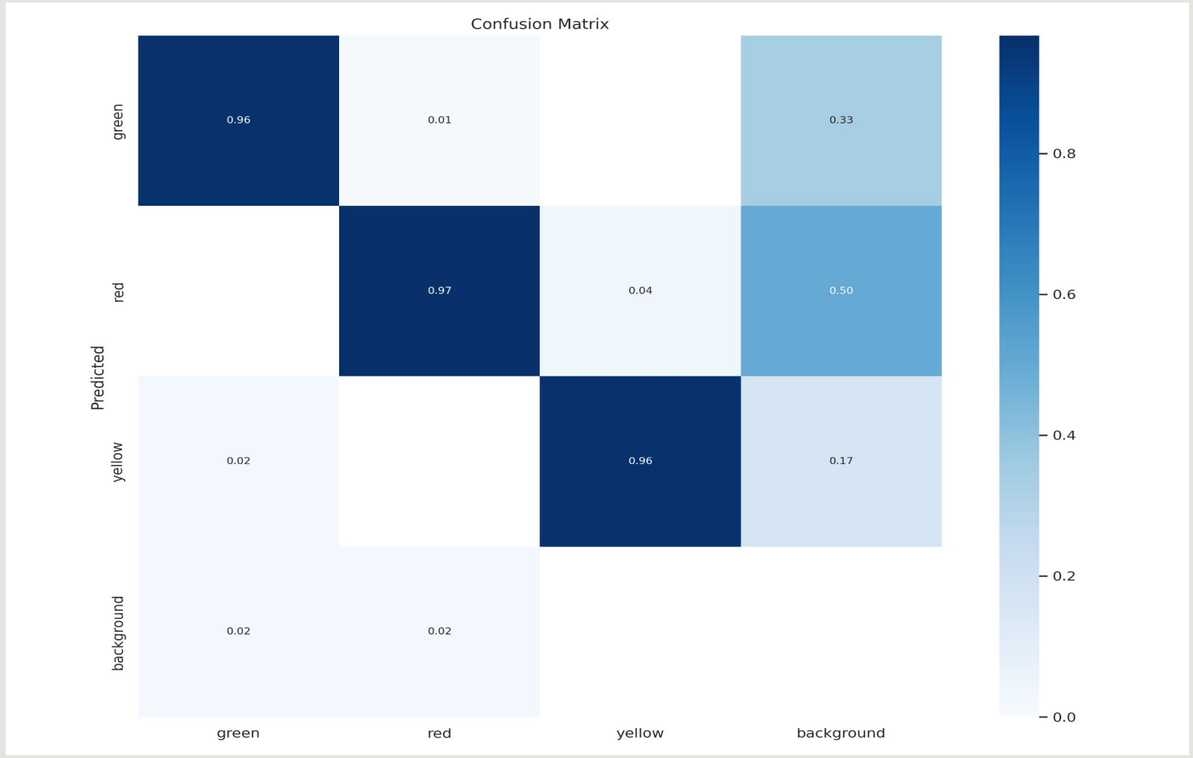
- Contains 2397 images.
- Trained YOLOv8 model

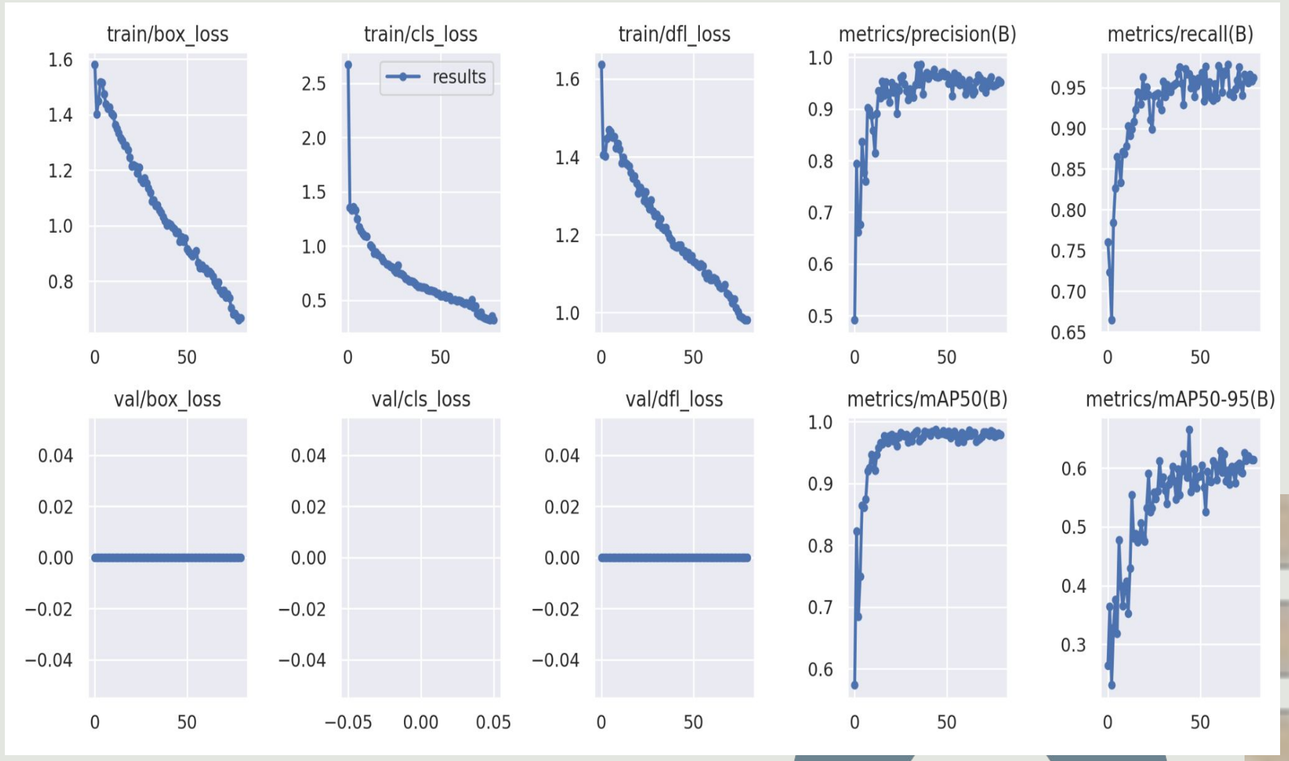
Dataset Split



Training the YOLOv8 Model

- Train the YOLOv8 model on the dataset with 80 epochs and an image size of 640.





WHITE LINE DETECTION

- Function: LineDetector.detect_white_line
- Process:
- Defines the Region of Interest (ROI) for detecting vehicle crossings.
- Applies Gaussian blur and edge detection to isolate the white line.
- Uses the Hough Line Transform to detect the average position of the line.
- Highlights the line on the frame based on the traffic light signal color.

LICENSE PLATE EXTRACTION

extract_license_plate

- Focuses on the area below the detected white line.
- Enhances the image using CLAHE and noise removal.
- Applies a Haar Cascade classifier to detect license plate regions.
- Crops and returns each detected license plate image.

OPTICAL CHARACTER RECOGNITION (OCR)

- Applies binary thresholding for optimal OCR performance.
- Converts the license plate image to a format compatible with pytesseract.
- Extracts alphanumeric text from the image and matches it against predefined patterns for valid license plates.

WORKFLOW

1)Video Processing:

- Downloads a sample traffic video using Google Drive.
- Iteratively processes each frame in the video.

2)Traffic Light and Line Detection:

- Detects the traffic light status using a pre-defined rectangular ROI.
- Detects white line crossings by vehicles.

3)License Plate Processing:

- When the signal is red, extracts vehicle license plates crossing the white line.
- Uses OCR to read and store license numbers of offending vehicles.
- Highlights traffic lights, white lines, and license plate regions in the video feed.
- Displays all penalized license plates on the video feed in real time.

OUTPUT VISUALIZATION

1)Video Feed:

- Traffic light detection with signal status (Stop, Caution, Go).
- White line detection.
- Highlighted license plates of violating vehicles.
- List of fined license plates dynamically updated on the frame.

2)Console Output:

- Prints all fined` license plate numbers for easy monitoring.

3)License Plate Images:

- Displays each extracted license plate as a cropped grayscale image for verification.

OUTPUT VISUALIZATION

Video Frame Showing Fined License Plate

To watch full video [Click here]

APPLICATIONS

1. Traffic Law Enforcement:
    - Automates detection of red-light violations, reducing manual monitoring efforts.
2. Smart City Solutions:
    - Integrates with traffic management systems for real-time data sharing.
3. Road Safety:
    - Enhances compliance with traffic signals to reduce accidents and improve road safety.