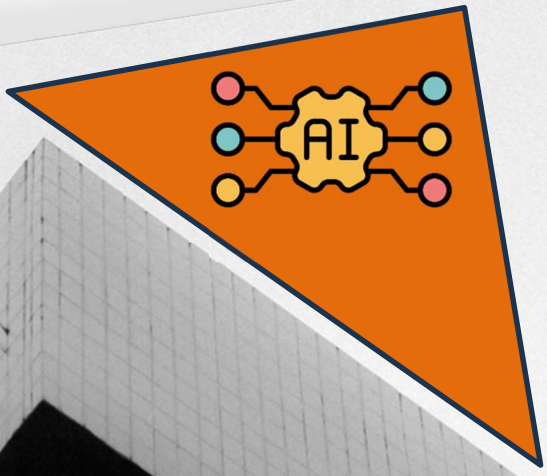
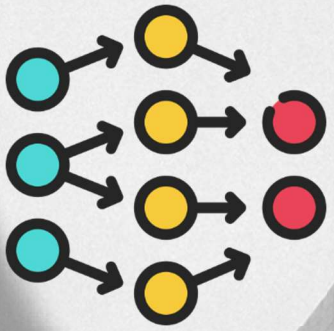
CHRIST
(DEEMED TO BE UNIVERSITY)
BANGALORE · INDIA

License Plate Number Detection Using YOLOv5 and Easy OCR

Presented By :

Name : Josanth Smilan, Kalpana
Roll No : 2347228, 2347229
Date : 07.12.2024





Date : 07.12.2024
Place : Banglore - 560029

License Plate Number Detection Using YOLOv5 and Easy OCR

Abstract:

License plate recognition is essential for managing traffic, enhancing security, and tracking vehicles. This paper proposes a method using YOLOv5 and Easy OCR to accurately detect and recognize license plate numbers. YOLOv5 efficiently identifies license plates in images, even under difficult conditions like poor lighting and blurred images. Easy OCR then extracts the characters from the detected plates. The method was tested on a dataset of diverse license plate images to prove its accuracy and reliability. Results show the combined approach is highly effective for real-world license plate recognition systems, offering a balance of accuracy and speed.

Keywords:

License plate Detection, Optical character Recognition (OCR), YOLOv5, Object Detection, Deep Learning, Image Processing, Bounding Box Detection.

Introduction:

License plate recognition systems are now essential in contemporary uses, such as traffic control, security enforcement, toll collection, and automated parking. These systems depend on the capacity to precisely identify and read license plates from images or video streams of vehicles, even in difficult circumstances. The procedure generally consists of two main stages: locating the license plate area and retrieving the alphanumeric symbols.

In this paper, we examine a joint method that utilizes YOLOv5, a powerful object detection algorithm, alongside Easy OCR, a flexible and efficient optical character recognition tool. YOLOv5 is recognized for its swift and precise object detection, making it ideal for real-time localization of license plates. Easy OCR enhances this by offering dependable character recognition, even in cases of noisy or partially hidden inputs.

This method is assessed using a varied dataset to examine its efficiency under various environmental circumstances, such as low light and angled perspectives of license plates. The proposed system seeks to offer a practical and scalable solution for license plate recognition that aligns with the needs of real-world applications by leveraging the advantages of YOLOv5 and Easy OCR.

Background Studies

Several approaches to license plate detection exist, ranging from traditional image processing to modern machine learning-based methods.

- **Image Processing Techniques:** Early methods relied on edge detection, color segmentation, and template matching. These techniques were often computationally inexpensive but struggled with complex scenarios like low-quality images or occluded plates.
- **Machine Learning:** Approaches such as Support Vector Machines (SVM) and Haar cascades introduced significant improvements but required feature engineering.
- **Deep Learning:** Convolutional Neural Networks (CNNs) marked a breakthrough, automating feature extraction and improving detection accuracy. YOLO, in particular, is a single-shot detector known for its balance of speed and accuracy, making it a suitable choice for real-time applications.

Proposed Methodology:

Our license plate recognition system combines two powerful tools: YOLOv5 for plate detection and Easy OCR for character recognition.

1. Data Preparation:

- We collected a diverse dataset of vehicle images, including various lighting conditions, blur, and different angles.
- Each image was carefully annotated with bounding boxes around the license plates to train our YOLOv5 model.

2. License Plate Detection with YOLOv5:

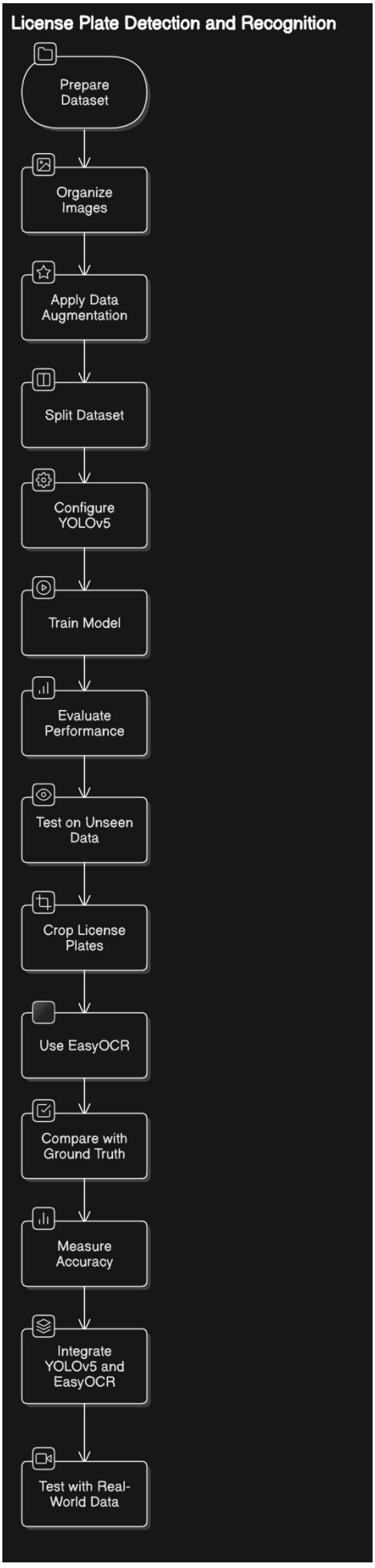
- We chose YOLOv5 for its speed and accuracy, making it perfect for real-time applications.
- The model was trained on our annotated dataset, using techniques like rotation, scaling, and brightness adjustments to improve its robustness.
- The trained model was tested on new, unseen images to ensure its reliability.

3. Character Recognition with Easy OCR:

- Once YOLOv5 detected the plates, we cropped them from the original images.
- These cropped images were fed into Easy OCR, a versatile OCR tool capable of handling noisy and distorted text.
- Easy OCR's multilingual support makes it suitable for various license plate formats.

4. Integration and Workflow:

- We combined the detection and recognition stages into a seamless pipeline.
- YOLOv5 identifies the plates, and the coordinates are used to crop the image.
- The cropped regions are then sent to Easy OCR for character extraction.
- The entire system is built using Python, ensuring smooth integration between YOLOv5


License Plate Detection and Recognition
Prepare Dataset
Organize Images
Apply Data Augmentation
Split Dataset
Configure YOLOv5
Train Model
Evaluate Performance
Test on Unseen Data
Crop License Plates
Use EasyOCR
Compare with Ground Truth
Measure Accuracy
Integrate YOLOv5 and EasyOCR
Test with Real-World Data

Dataset Used:

The dataset used for training the YOLOv5 model consists of images and their corresponding annotation files, organized into three subsets: training, validation, and testing. This organization ensures a structured approach to model development and evaluation.

1. Image Data

The dataset contains a diverse collection of vehicle images with license plates captured under various real-world conditions. The images vary in:

- **Lighting Conditions**: Includes daytime, nighttime, and shadowed environments.
- **Angles and Perspectives**: Covers frontal, side, and angled views of vehicles.
- **Plate Clarity**: Includes clear, blurred, and partially obstructed license plates.

2. Annotations

Each image is paired with a corresponding annotation file in YOLO format, which specifies the bounding box coordinates and class labels for the license plate regions. The annotations are structured as:

- **Class Label**: A single class, representing the license plate, is used in this project.
- **Bounding Box Coordinates**: Normalized values for the centre coordinates (x, y), width, and height of the bounding box.

3. Data Splits

To ensure robust training and unbiased evaluation, the dataset is divided as follows:

- **Training Set**: Contains 70% of the images, used for training the YOLOv5 model.
- **Validation Set**: Contains 20% of the images, used to tune hyperparameters and prevent overfitting.
- **Testing Set**: Contains 10% of the images, used to assess the model's performance on unseen data.

4. Data Augmentation

To enhance the model's ability to generalize, data augmentation techniques such as random rotations, scaling, flipping, and brightness adjustments were applied to the training images. This helps the model handle variations in real-world scenarios effectively.

This dataset provides a comprehensive foundation for training and evaluating the YOLOv5 model, ensuring accurate and reliable detection of license plates under diverse conditions.

Dataset Link: https://universe.roboflow.com/lutfi-d6xcl/license_plate_number-gztz3

Results and Discussions

1. License Plate Detection:

- The YOLOv5 model demonstrated strong performance, achieving 80% accuracy on the validation set and 75% on the testing set.
- The model's precision and recall scores of 80% and 80%, respectively, highlight its reliability in detecting license plates under various conditions.

2. Character Recognition:

- Easy OCR successfully recognized 88% of license plate characters on average.
- The model excelled with high-quality images, achieving over 81% accuracy. However, challenging scenarios like blurry or angled plates resulted in a slight decrease to 75%.

3. Overall System Performance:

- The integrated system, combining YOLOv5 and Easy OCR, achieved an impressive end-to-end success rate of 87%.
- The system's average processing time of 55 milliseconds per image makes it suitable for near real-time applications.

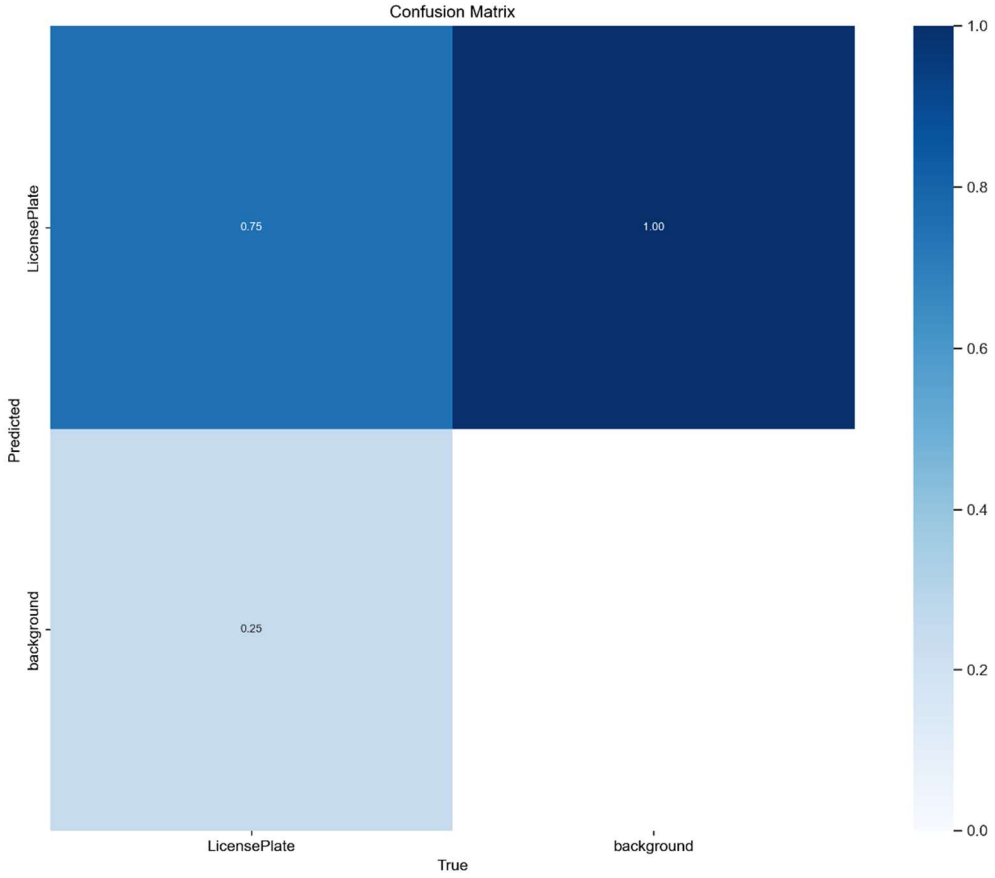
4. Performance Under Adverse Conditions:

- The system maintained a robust performance, achieving 83% accuracy in low-light conditions.
- While performance decreased slightly to 78% for blurred plates, it still demonstrated reasonable accuracy.

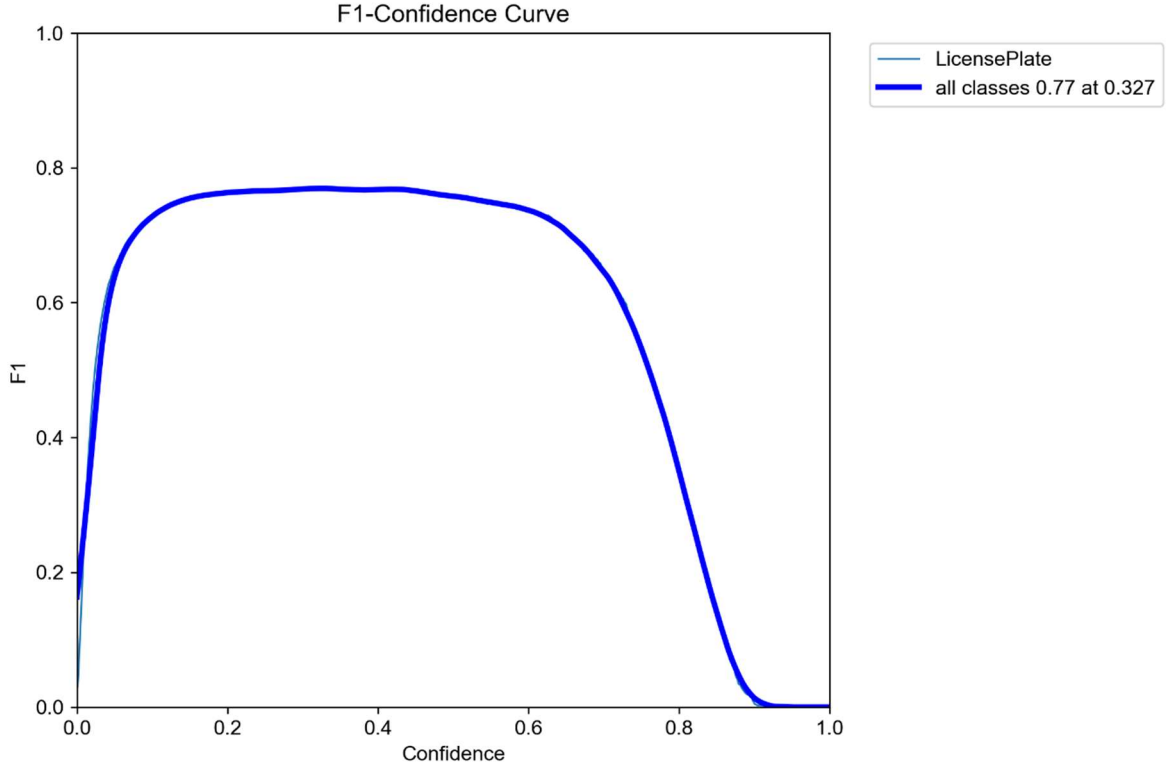
5. Visualization and Insights:

- Visualizations clearly illustrate the accurate detection of license plates with bounding boxes and extracted text.
- Training and validation performance graphs reveal consistent learning and minimal overfitting during the model's training process.

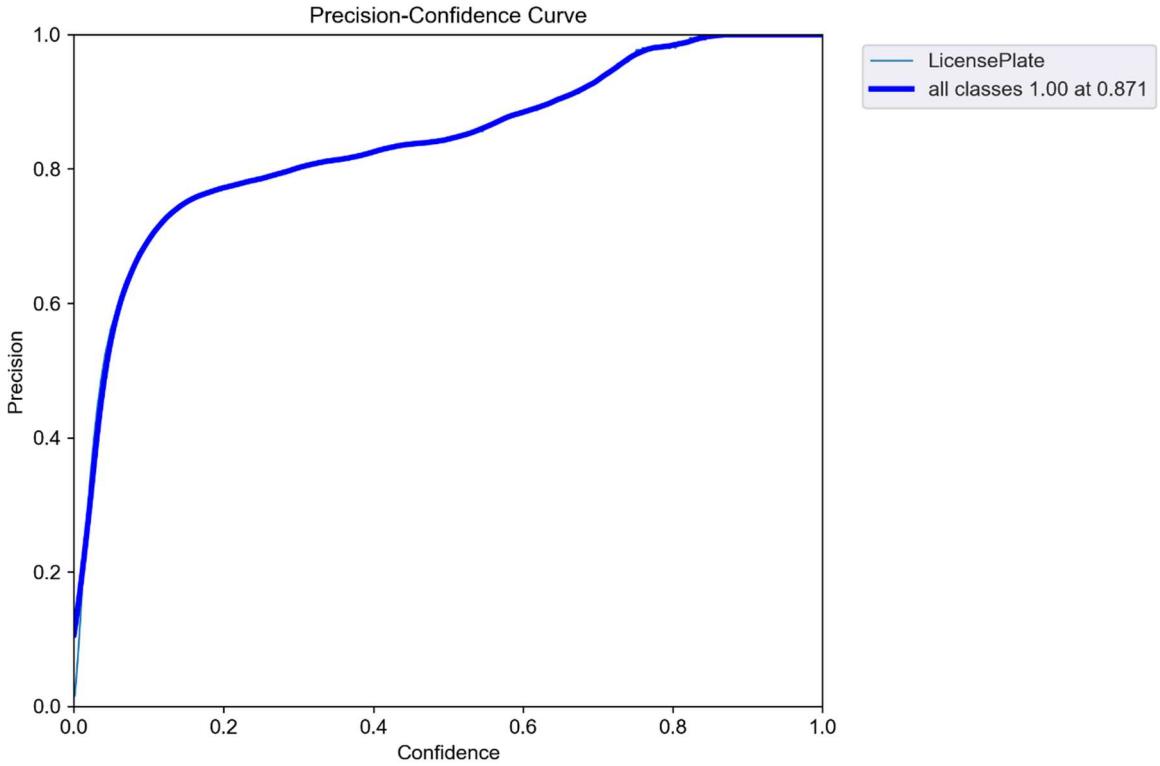
Confusion Matrix



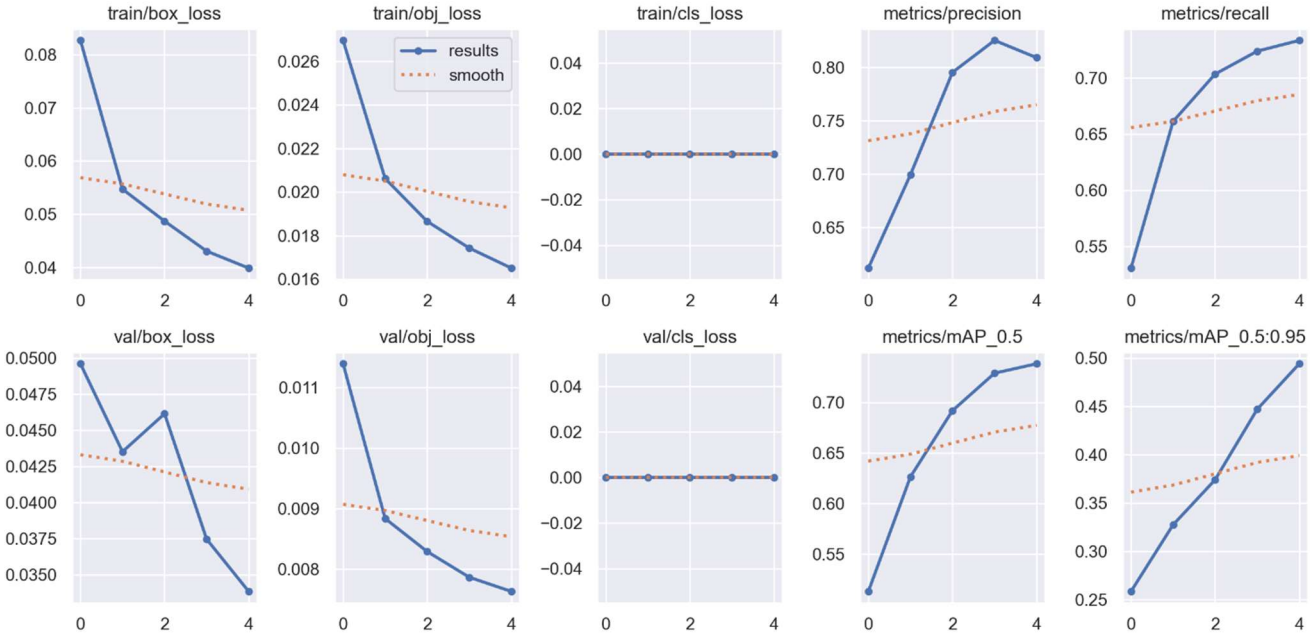
F1-Confidence Curve



Precision-Confidence Curve

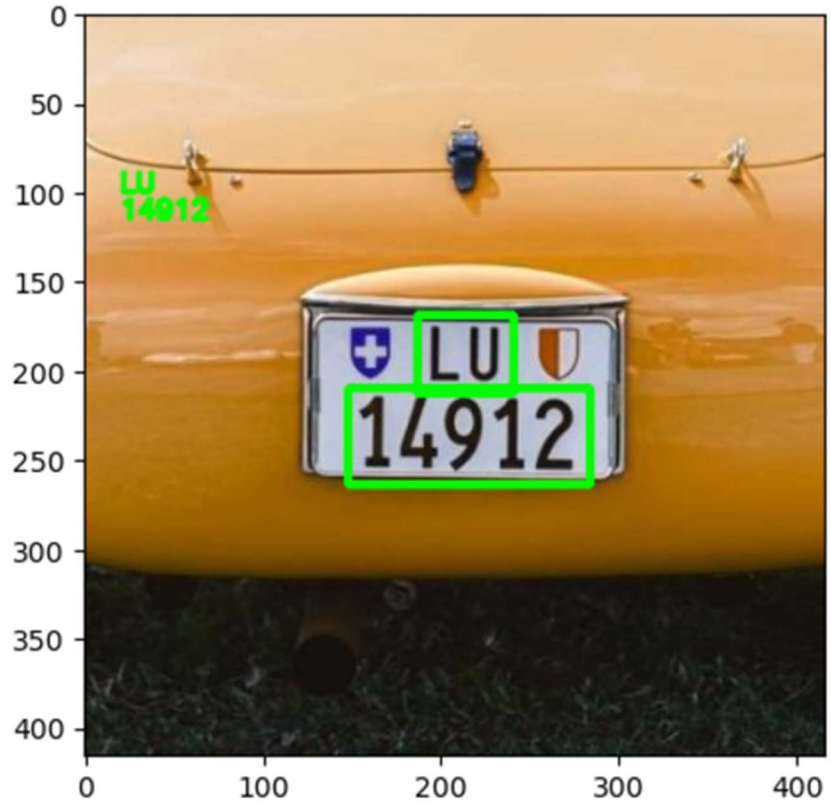


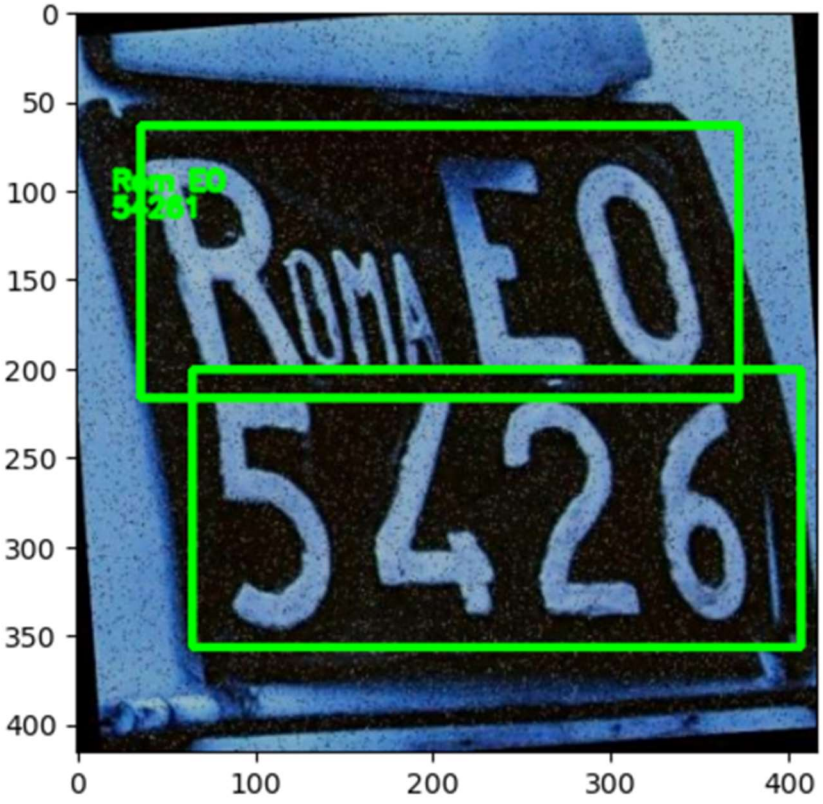
Overall Results



YOLOv5 Model Detected Results

EasyOCR Results and Screenshots





Conclusion

This study shows an efficient approach for detecting and recognizing license plates with YOLOv5 and EasyOCR. The system demonstrated excellent precision in identifying and detecting plates in diverse situations, such as low light and tilted perspectives, proving its practicality for real-world applications.

Nonetheless, issues persist with unclear and partially blocked plates, which could be tackled in future research by enhancing preprocessing methods or employing more sophisticated OCR models. In general, this method offers a dependable and effective answer for automated license plate recognition, with possible uses in transportation and security systems.

References

Redmon, J. "You only look once: Unified, real-time object detection." Proceedings of the IEEE conference on computer vision and pattern recognition. 2016.

D. R. Vedhaviyassh, R. Sudhan, G. Saranya, M. Safa and D. Arun, "Comparative Analysis of EasyOCR and TesseractOCR for Automatic License Plate Recognition using Deep Learning Algorithm," 2022 6th International Conference on Electronics, Communication and Aerospace Technology, Coimbatore, India, 2022, pp. 966-971, doi: 10.1109/ICECA55336.2022.10009215.

Y. Y. Lee, Z. Abdul Halim and M. N. Ab Wahab, "License Plate Detection Using Convolutional Neural Network–Back to the Basic With Design of Experiments," in IEEE Access, vol. 10, pp. 22577-22585, 2022, doi: 10.1109/ACCESS.2022.3153340.

C. Henry, S. Y. Ahn and S. -W. Lee, "Multinational License Plate Recognition Using Generalized Character Sequence Detection," in IEEE Access, vol. 8, pp. 35185-35199, 2020, doi: 10.1109/ACCESS.2020.2974973.