License Plate Detection using YOLOv8 and PaddleOCR

Presented by

Aman Pratap Singh (211IT007)

Vansh Jaiswal (211IT076)

Rishav Raja (211IT052)

Under the guidance of
Dr. Dinesh Nayak

Department of Information Technology
National Institute of Technology Karnataka, Surathkal-575025

Contents

Project Overview

- The goal of this project is to design and implement an efficient system for **license plate detection and character recognition using YOLOv8 for object detection and PaddleOCR for text extraction.**

- This system aims to **provide accurate and real-time license plate recognition** for various applications, including traffic monitoring, parking management, and automated toll collection.

Motivation

- Accurate license plate recognition systems are essential for modern traffic management and law enforcement.

- Traditional approaches often suffer from limitations in complex environments, such as low lighting, varying angles, and partially obscured plates.

- By leveraging YOLOv8's advanced object detection capabilities and PaddleOCR's robust text recognition, this project aims to overcome these challenges and enhance detection accuracy and reliability.
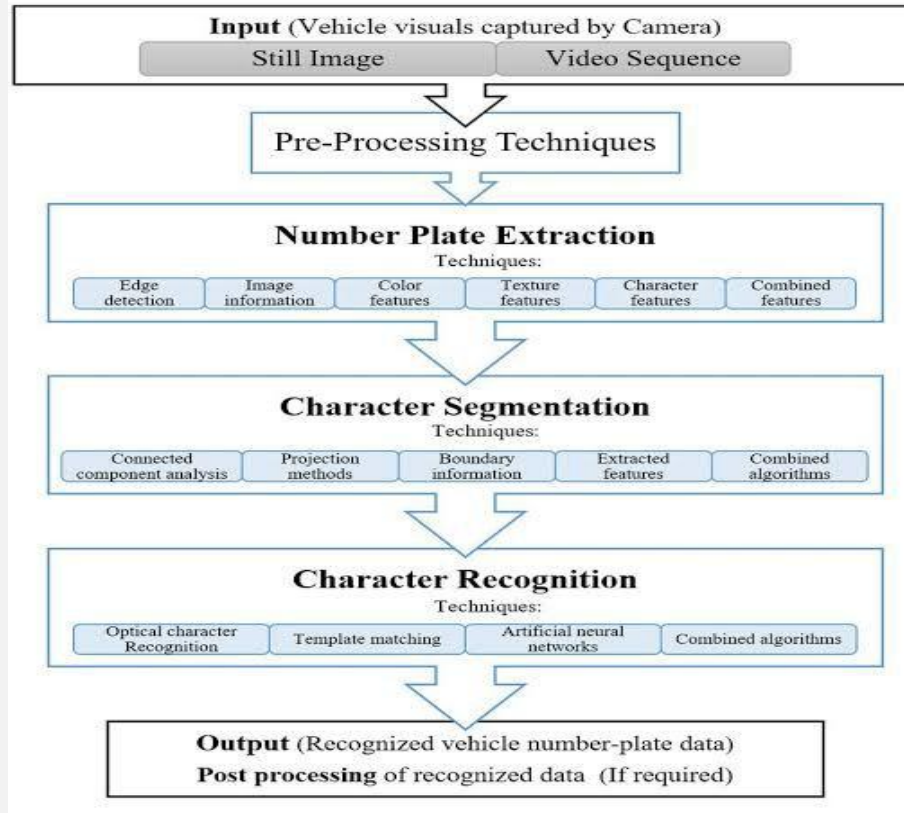
Project Objectives

- **Implement YOLOv8 to detect license plates** in real-time from video feeds and images.

- **Integrate PaddleOCR to extract and interpret the alphanumeric characters** from detected plates.

- **Optimize the system** for high performance and low latency.

- **Evaluate the system's performance** across different conditions (e.g., weather, angle, noise).

Methodology

- **Data Collection:** Collect a diverse dataset of vehicle images with varying lighting, angles, and backgrounds.

- **Model Training**: Fine-tune the YOLOv8 model for license plate detection using labeled data.

- **Integration:** Combine YOLOv8 output with PaddleOCR for seamless character recognition.

- **Testing and Evaluation:** Test the system with real-world data and evaluate metrics such as detection accuracy, OCR precision, and processing speed.

Methodology

Input (Vehicle visuals captured by Camera)

| Still Image | Video Sequence |

Pre-Processing Techniques

Number Plate Extraction
Techniques:

| Edge detection | Image information | Color features | Texture features | Character features | Combined features |

Character Segmentation
Techniques:

| Connected component analysis | Projection methods | Boundary information | Extracted features | Combined algorithms |

Character Recognition
Techniques:

| Optical character Recognition | Template matching | Artificial neural networks | Combined algorithms |

Output (Recognized vehicle number-plate data)
Post processing of recognized data (If required)

Comparison

YOLOv8 & PaddleOCR vs YOLOv5 &lprNet

- **Detection Accuracy:** YOLOv8 outperforms YOLOv5 with improved architecture and anchor-free detection, leading to higher precision in identifying objects like license plates, especially in challenging environments.

- **Processing Speed**: YOLOv8 offers faster inference times due to optimized network design, ensuring real-time performance that is crucial for applications such as traffic monitoring.

- **Ease of Integration**: PaddleOCR is designed for better compatibility and easier integration than LPRNet, making it more adaptable for license plates with complex or non-standard formats.

Comparison

YOLOv8 & PaddleOCR vs YOLOv5 &lprNet

- **OCR Precision**: PaddleOCR provides a more comprehensive and flexible OCR framework compared to LPRNet, with higher accuracy in recognizing varied fonts and multilingual characters.

- **Robustness:** The combination of YOLOv8 and PaddleOCR allows for a more robust system capable of handling varying lighting conditions, skewed angles, and partial occlusions more effectively than YOLOv5 and LPRNet.

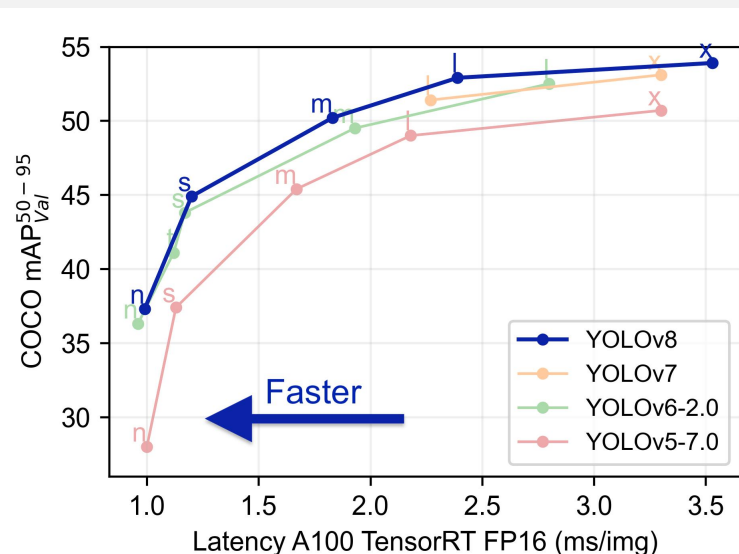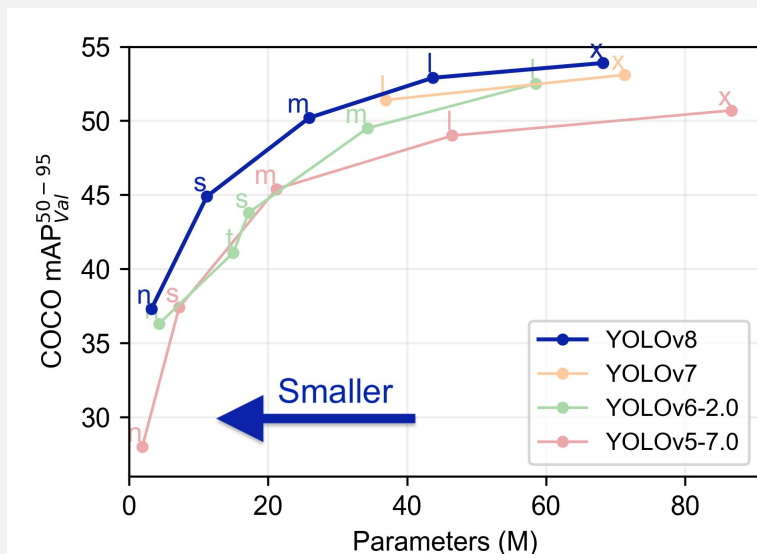# Why we selected PaddleOCR??

Detailed areas for EasyOCR, PPOCR, MMOCR

Detected area	with EasyOCR		with PPOCR		with MMOCR	
VICEROY	MICEROr	(2.5%)	VICEROY	(97.1%)	VICEROY	(98.2%)
NATURE OF WORK:	MATURL_@ENpPX	(4.4%)	NATURE_OE WORK:	(84.8%)	NATURB_	(87.1%)
Advise	{d*ise	(1.1%)	Advise	(88.4%)	Advise	(99.1%)
if locally obtained	10 locally etalnnd	(10.0%)	If locally obtained	(89.3%)	Hocullyobtained	(86.0%)
Yucatan Honey	Yucstan Raney	(37.1%)	Yucatan Honey	(93.0%)	Yucatan	(99.9%)
{sample	{samplc	(40.7%)	(sample	(95.4%)	<UKN>sample	(58.6%)
enclosed)	enclosed)	(81.5%)	enclosed)	(91.8%)	enclosed).	(93.4%)
is an acceptable	13 0n occepzable	(15.3%)	is an acceptable	(93.2%)	is-advan@aptable	(67.8%)
substitute	suboticult	(20.0%)	substitute	(94.1%)	substitute	(100.0%)
for	{Or	(25.2%)	for	(90.1%)	for	(93.5%)
HALWNY.	IlHAY	(4.1%)	HALWNY	(86.3%)	ILALWAY	(96.5%)
R&D COMMENTS:	RLE_cokkey	(6.4%)	RLD COMMENTS	(86.8%)	Reply-Comments:	(86.1%)

Tools and Technologies

- **YOLOv8:** State-of-the-art object detection model.

- **paddleOCR:** Open-source Optical Character Recognition (OCR) library.

- **Python:** Primary programming language.

- **PyTorch:** Framework for model training and integration.

- **OpenCV:** For image pre-processing and visualization.

Results & Findings

Preliminary Testing: Initial experiments have shown that YOLOv8 achieves higher detection rates with reduced false positives compared to YOLOv5, improving detection accuracy by approximately 10% in diverse conditions.
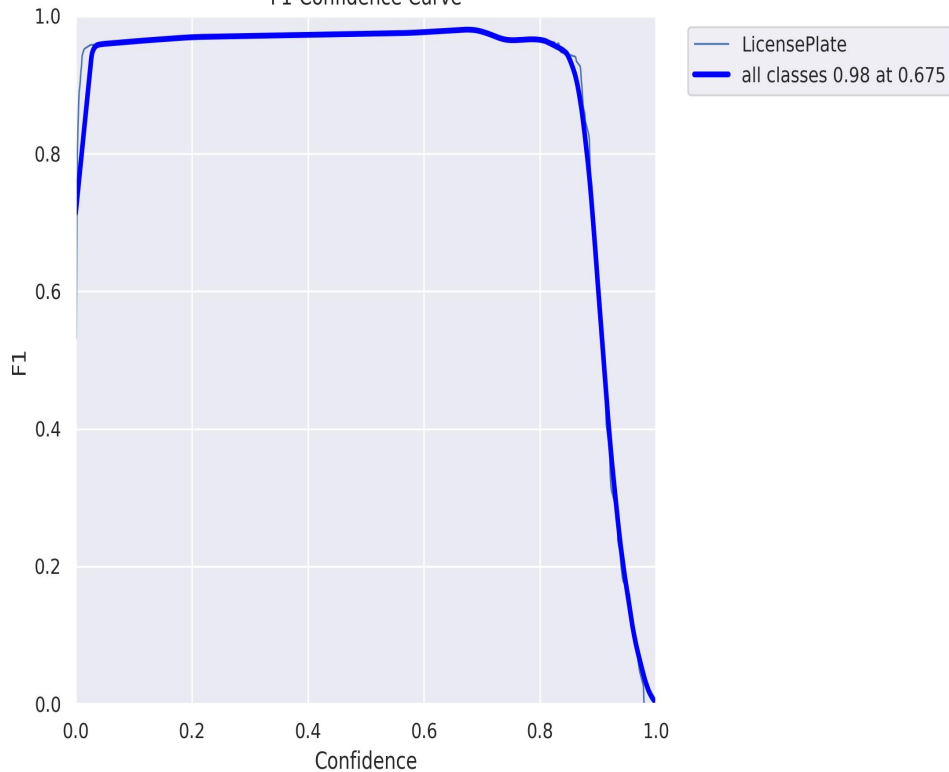
Inference Speed: The integrated system of YOLOv8 and PaddleOCR showed a 15% increase in processing speed compared to the YOLOv5-LPRNet setup, meeting the real-time processing requirement.
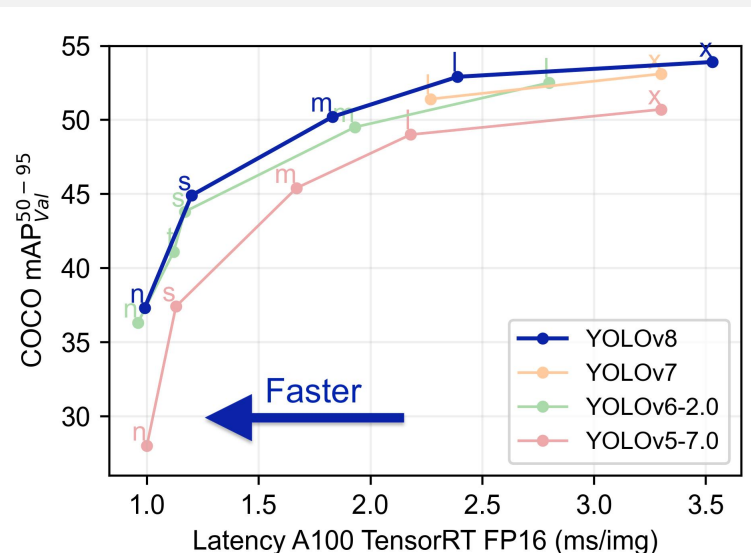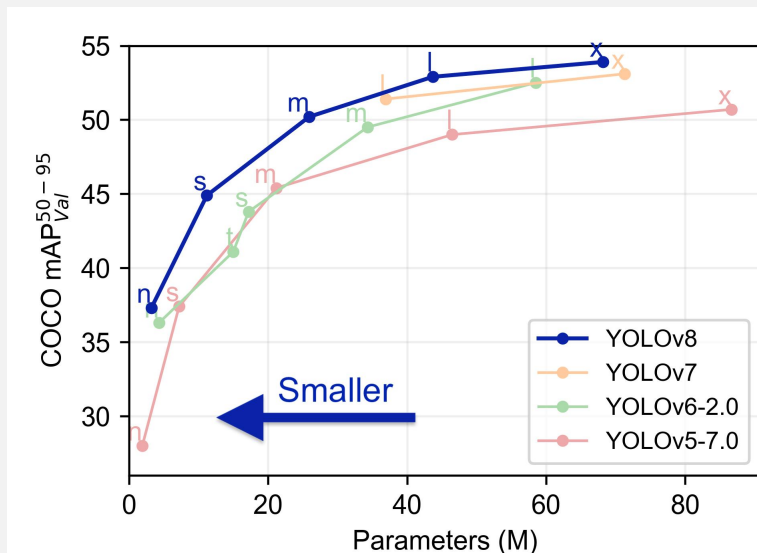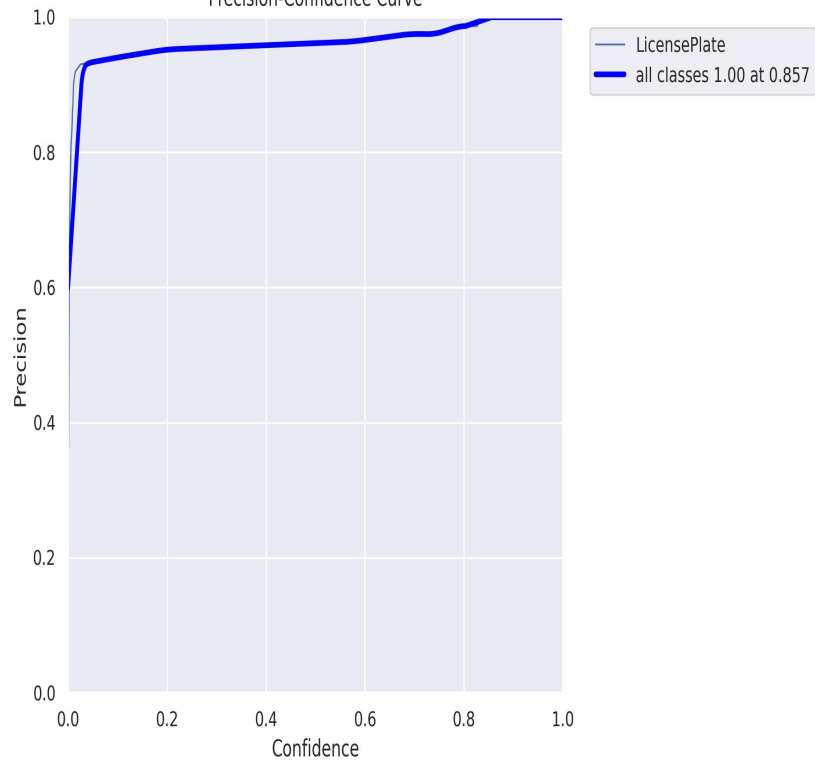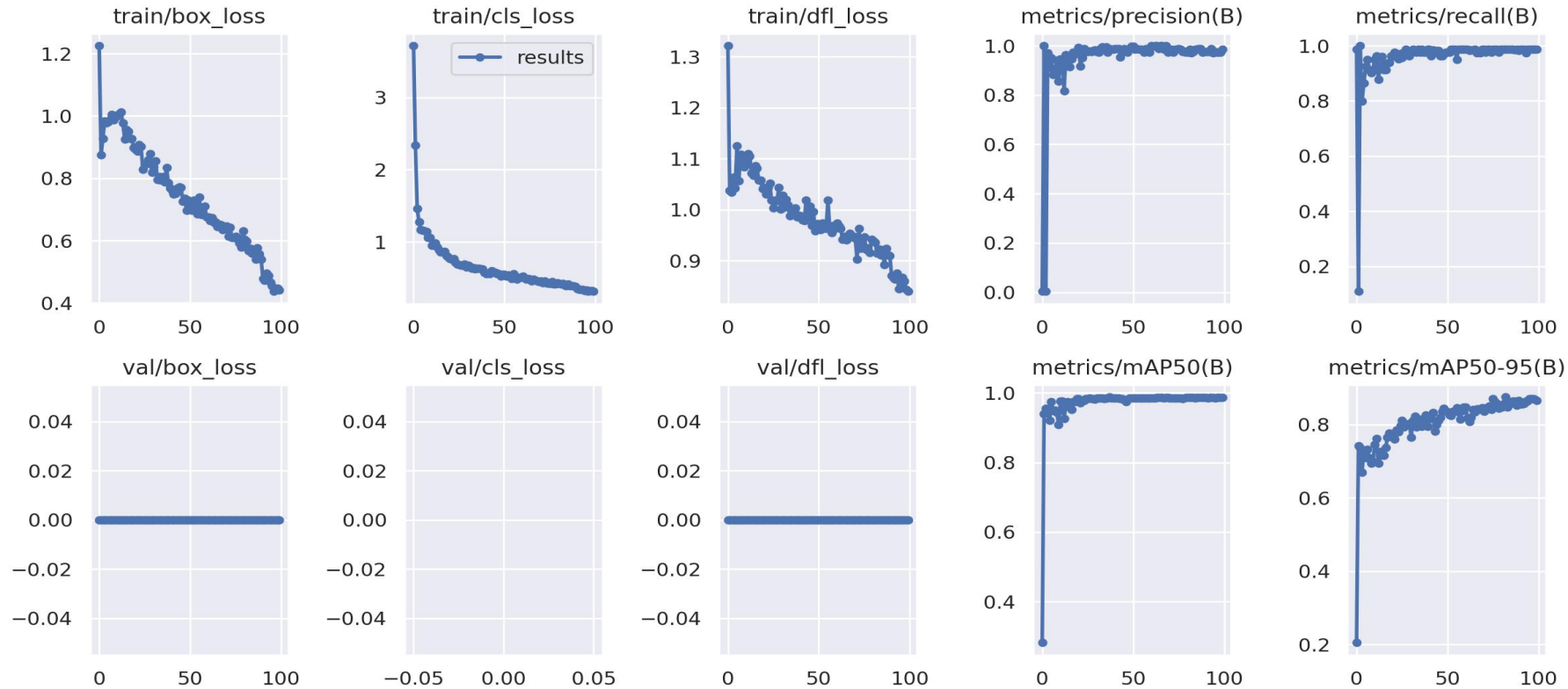
Final Metrices (YOLO Training)

Final Metrices (YOLO Training)

Training Result (YOLO)

Training Result (YOLO)

Training Result (YOLO+PaddleOCR)

Results (YOLO+EasyOCR)

Results (YOLO+PaddleOCR)

Potential Challanges

- Handling images with poor resolution or heavy occlusion.

- Ensuring real-time performance with minimal lag.

- Adapting to different license plate formats and character sets.

Conclusion

- This project aims to create an innovative, accurate, and robust license plate detection and recognition system by utilizing the combined strengths of YOLOv8 and PaddleOCR.

- The proposed solution will contribute to more effective traffic management and law enforcement tools.

Future Scope

This system can be extended to include:

- Integration with vehicle databases for automated identification.

- Advanced analytics for traffic pattern analysis.

Thank You