Plate detection with YOLO

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This document delves into a system designed for car detection and license plate extraction from images. The project aimed to establish a robust solution by leveraging a customized YOLO (You Only Look Once) model for vehicle detection and advanced image processing techniques for precise license plate extraction. Two distinct attempts were made, the first utilizing YOLO for vehicle detection but encountering challenges in accurately extracting license plates due to lighting and image quality variations. In response, a second attempt refined techniques, emphasizing advanced image processing and a customized YOLO model specifically tailored for plate detection. The project aimed to develop a reliable system vital for automated surveillance and traffic management. The document encompasses methodologies, technologies, areas for improvement, and potential future enhancements.

1. MOTIVATION OF THE WORK

The detection of vehicles and the efficient extraction of license plates from images are crucial elements in surveillance systems, road safety, and traffic management. This proposal addresses the need to develop a system capable of identifying cars and extracting their license plates accurately and swiftly, essential in automating surveillance processes and vehicle control. The aim is to provide a robust solution allowing automated recognition and registration of vehicles in complex environments.

2. PROPOSAL OBJECTIVE

The primary objective of this project is to implement a vehicle detection system using YOLO, an object detection algorithm, and subsequently extract the license plates of these vehicles using image processing techniques and optical character recognition (OCR). The purpose is to offer a comprehensive solution that enables precise and efficient identification and registration of vehicles in various conditions and environments, and propose an efficient and robust method.

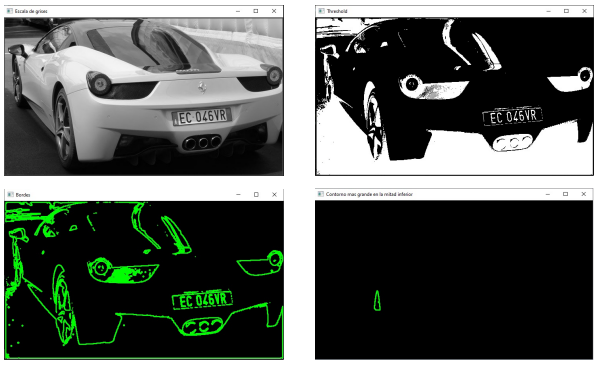
3. TECHNICAL DESCRIPTION OF THE WORK DONE

A. Implementation of YOLO for Car Detection

The implementation of YOLO (You Only Look Once) is based on a pre-trained model capable of detecting various objects, including vehicles, in images. This technique allows for the accurate identification of cars within a diverse set of objects. The first part of the project consist in detecting a car in an image and separating it from the background with the typical rectangle segmentation tool

B. First attempt of Extraction of Vehicle License Plates

The methodology used for license plate extraction relies on image processing techniques and contour detection. This stage aims to isolate and segment the license plates of detected vehicles for further analysis. After successfully detecting vehicles, the subsequent step involved processing the regions of interest (ROI) containing the vehicles to extract the license plates, in particular the lower portion of the car image, as assumption. Techniques such as image segmentation, contour detection, and region-based processing were explored to isolate and extract the license plate information from the identified vehicles. However, this initial approach faced challenges in accurately extracting license plates due to variations in lighting, angles, and image quality.



C. Second attempt of Extraction of Vehicle License Plates

In the second attempt, the focus shifted towards a refined approach for license plate extraction after vehicle detection. The revised strategy involved a more detailed and comprehensive methodology specifically tailored to extract license plates from the regions identified as vehicles in the images.

Advanced image processing techniques, including grayscale conversion, thresholding, canny edge detection (that actually improved a lot the final result), contour detection, and area-based filtering, were implemented to precisely locate and isolate the license plate areas within the detected vehicles. Additionally, optimizations were made in the contour selection process, emphasizing the accuracy of identifying and extracting the regions likely to contain license plate information.

This second attempt aimed to overcome the limitations encountered in the initial phase by refining the techniques used for license plate extraction, aiming for better accuracy and robustness in recognizing and extracting license plates from the

detected vehicles, even under varying conditions and image qualities.

D. Text Recognition with Tesseract OCR

The integration of Tesseract OCR enables the recognition and extraction of text present in the identified license plates. Despite the challenges inherent in the variety of formats and conditions of license plates, this tool offers a versatile solution for text identification.

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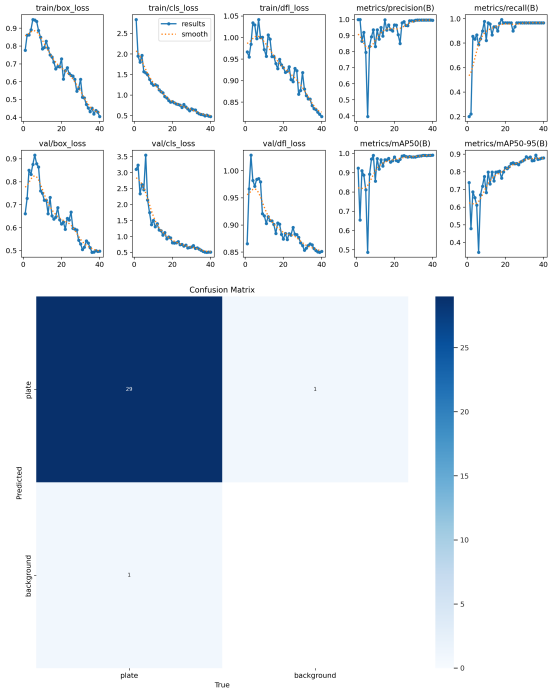
E. Custom Trained Yolo Model

In this phase, our approach diverged from manual processing. Instead, we delved into training a custom detector using YOLOv8. To kickstart the training, we began with image annotation. Utilizing a dataset from Roboflow, which included 200 pre-labeled license plate images, simplified our task. With the dataset neatly organized into train, validation, and test folders, exporting it into YOLOv8 format was straightforward. Once images and annotations were compiled, we crafted a .yaml file, crucial for training with the YOLOv8 model. This file defined essential parameters such as the directories for training, validation, and testing, along with the class names and the number of classes. Armed with labeled images in YOLOv8 format, the .yaml file, and the yolov8n.pt model, we initiated training. Upon successful training, a visual summary showcased the reduction in loss function and the precision enhancement per epoch, confirming a fruitful training session. With the training accomplished, we introduced the model plate—our trained detector primed to spot license plates. We then formulated a detection function to adeptly identify and display license plates within vehicle images.



4. SOURCES AND TECHNOLOGIES USED

Various technologies and tools were employed in this project, including OpenCV for image processing, YOLO for object detection, and Tesseract OCR for optical character recognition. These technologies offer robust and complementary capabilities that were crucial in developing a comprehensive system for detection and license plate extraction.

5. CONCLUSIONS AND EXPANSION PROPOSALS

A. Results and Conclusions

The results obtained in vehicle detection and license plate extraction showed considerable efficacy in accurately identifying cars and recognizing license plates under diverse conditions. However, areas for improvement were identified to increase the system's accuracy and performance in more challenging environments.

B. Improvement and Expansion Proposals

To enhance the system's efficiency and precision, exploring advanced image processing techniques and specific model training for license plate recognition under different lighting conditions and format variabilities is proposed. Additionally, integrating post-processing algorithms could increase accuracy in license plate identification. Another interesting path of investigation could be working on video instead of images.

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