DATA SCIENCE

Computer Vision Project

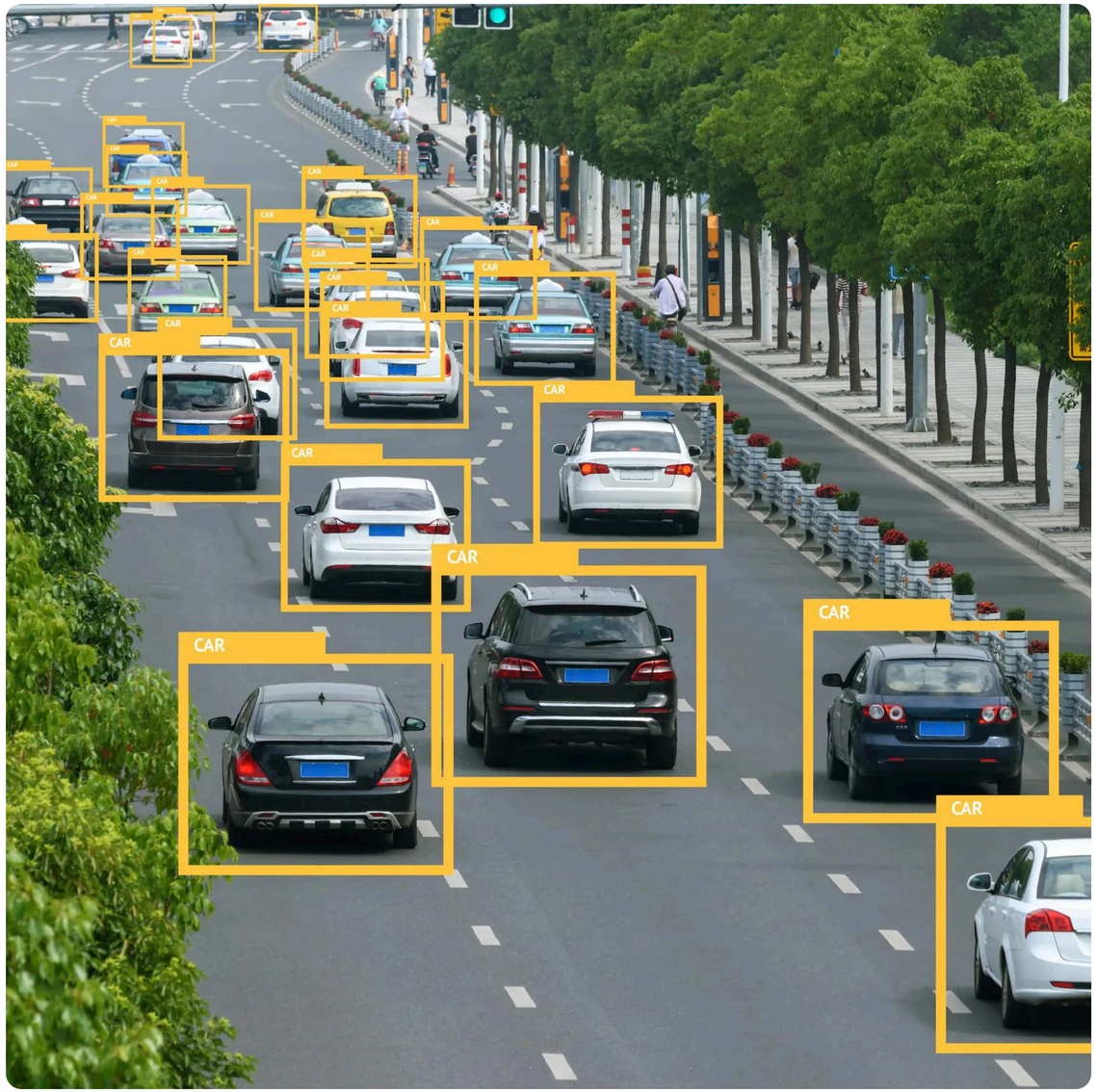
Oussema Zarrouki - Yessin toumi - Youssef Saidani

Table of contents

BUSINESS UNDERSTANDING

Objective:

The goal of this project is to develop a system that can detect vehicles, recognize license plates, and estimate vehicle speeds from video footage. The system is designed with potential applications in traffic monitoring, toll collection, and law enforcement.



BUSINESS UNDERSTANDING

Success Metrics

01

License Plate Detection Accuracy

The percentage of plates accurately detected and recognized.

02

Car Detection Accuracy:

The ability to correctly identify vehicles in video frames.

03

Licence Plate Reading Accuracy:

The accuracy of detecting and recognizing text from license plates.

Data Understanding

Video Input:

Process video footage of cars on the road.

Define source and target polygons for perspective correction.

Sufficient resolution and frame rate for vehicle detection and speed estimation.

Cars Dataset:

- Contains data of multiple cars in Tunisia, captured using a phone.
- Includes annotations for license plate positions, numbers, and types, used to train the model.

Data Set Examples

Data Preparation

Annotations for license plates and their corresponding classes were created using Roboflow.

The dataset was split into 70% for training, 20% for validation, and 10% for testing.

Images were resized and license plates cropped.

Preprocessing included image normalization, thresholding, grayscale and more to improve text recognition.

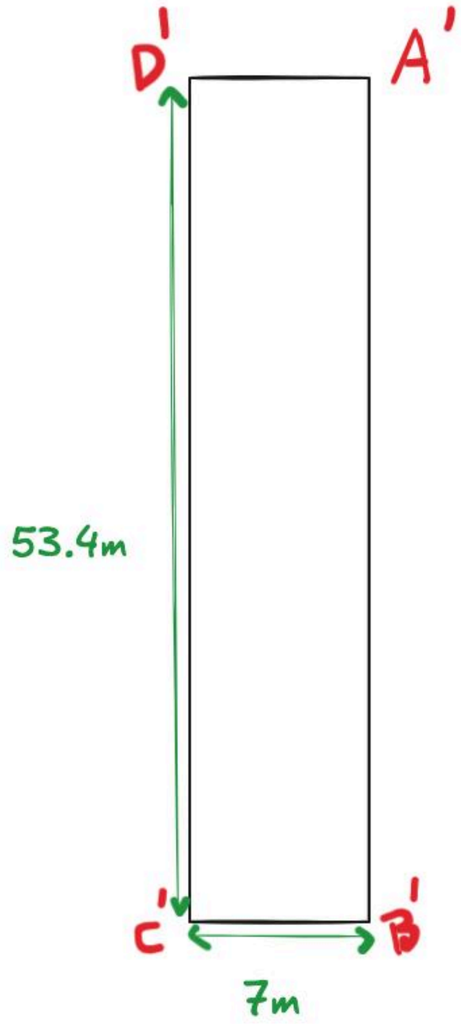

```
    "year": "2024",
    "version": "1",
    "description": "Exported from roboflow.com",
    "contributor": "",
    "url": "https://public.roboflow.com/object-detection/undefined",
    "date_created": "2024-11-30T22:02:37+00:00"
},
"licenses": [
    {
        "id": 1,
        "url": "https://creativecommons.org/licenses/by/4.0/",
        "name": "CC BY 4.0"
    }
],
"categories": [
    {
        "id": 0,
        "name": "licenseplate-car",
        "supercategory": "none"
    },
    {
        "id": 1,
        "name": "Car",
        "supercategory": "licenseplate-car"
    },
    {
        "id": 2,
        "name": "license_plate",
        "supercategory": "licenseplate-car"
    }
],
"images": [
    {
        "id": 0,
        "license": 1,
        "file_name": "81_png.rf.03bb87ff57a6efb59d2a6709968031fd.jpg",
        "height": 640,
        "width": 640,
        "date_captured": "2024-11-30T22:02:37+00:00",
```

Perspective Correction

Real-world coordinates were measured based on the video.

Four points (source) were identified in the video, and four corresponding points (target) were taken from real-world values.

This allows for a transformation to correct the perspective.



Modeling

Yolov8

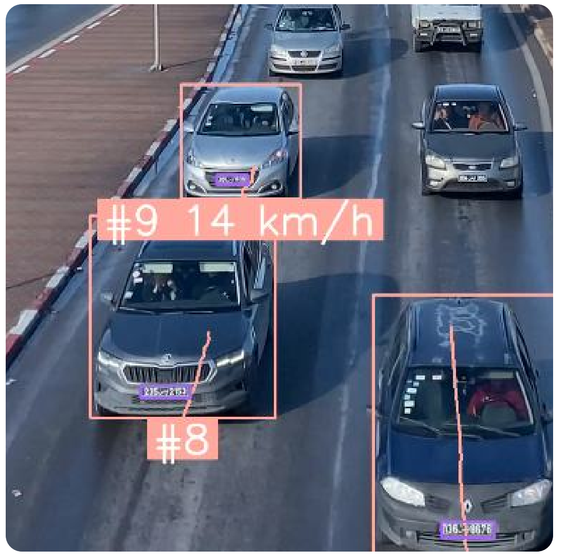
was used for detecting vehicles in the video, providing real-time object detection.

Roboflow Universe Model

was employed for license plate detection, enabling accurate localization of plates.

EasyOCR / Custom Built Model

were used together for reading license plate text and classifying plate types.



Speed Detection Algorithm

was implemented to estimate vehicle speeds using distance, time, and perspective correction for improved accuracy.

Evaluation

Car Detection

The car detection is performed using the YOLOv8 model.

Confidence from the model is measured and filtered with thresholds that can be adjusted based on parameters.

Speed Detection

While real-world speed values are unavailable, the perspective transformation estimates speeds based on distance and time.

Metrics like variance could be considered, but they are not directly relevant without real-world speed data.

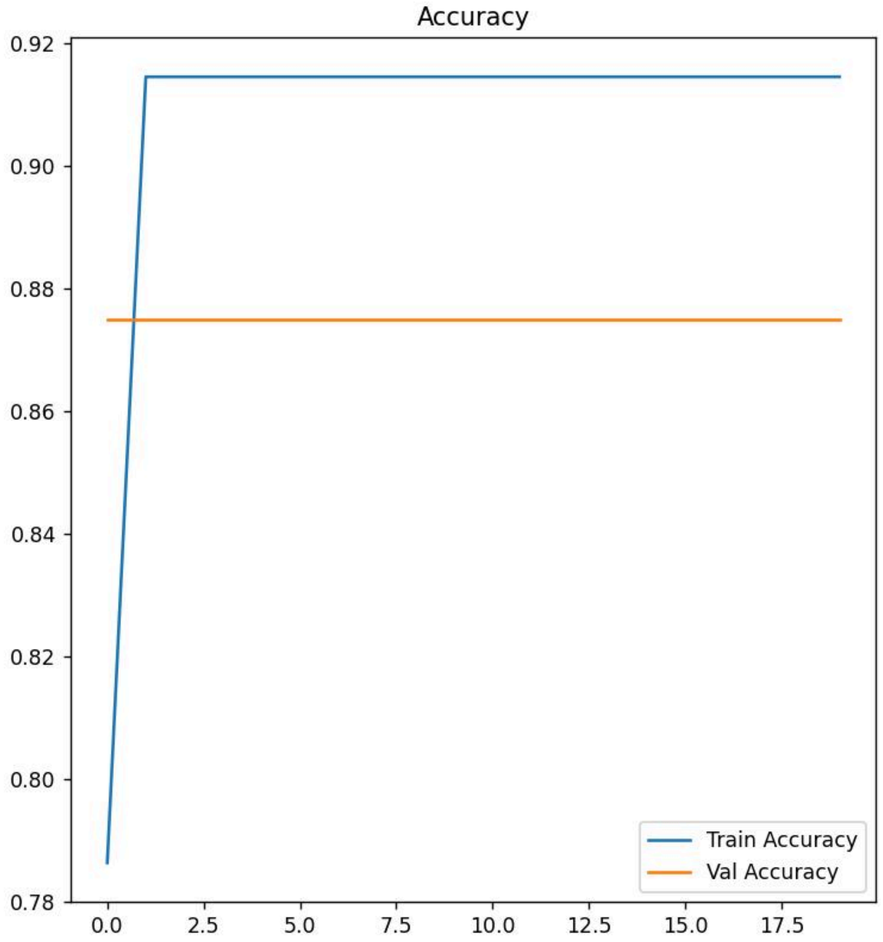
License Plate Detection

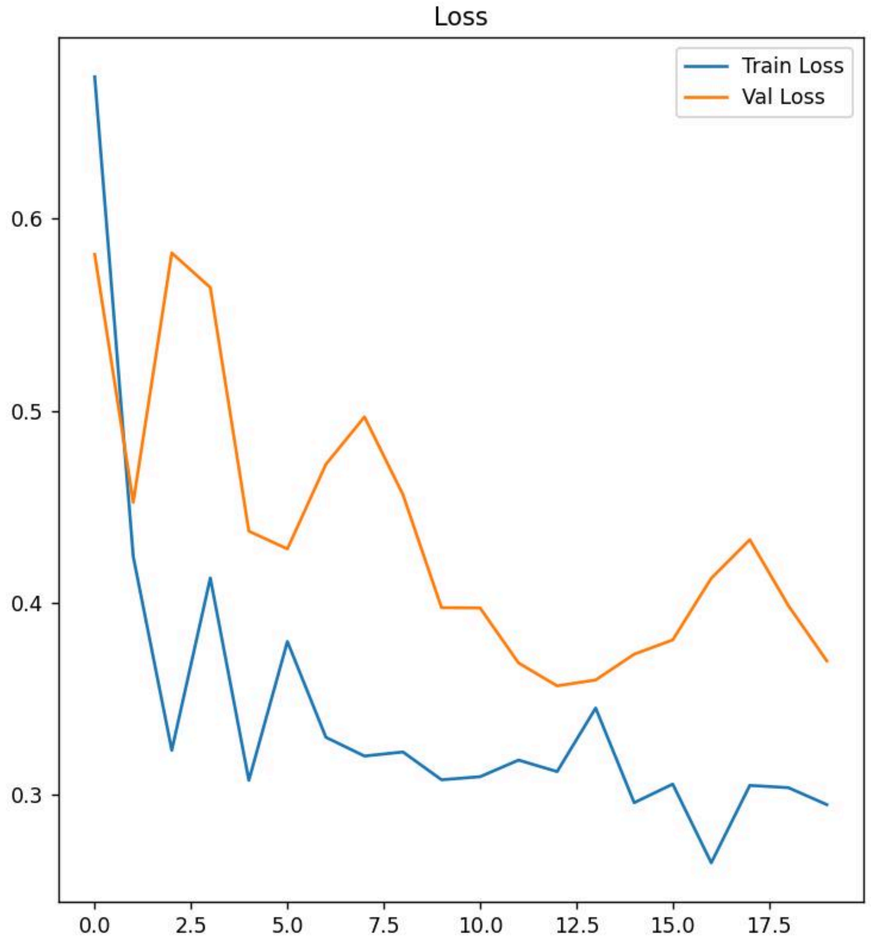
License plate detection relies on the confidence returned by the Roboflow model.

The model's confidence score is used to evaluate detection accuracy.

License Plate Reading

The accuracy and loss are used to evaluate the effectiveness of the license plate text reading process.





Classification Metrics for the model detecting “تونس” license plate

Best Left Threshold Image :

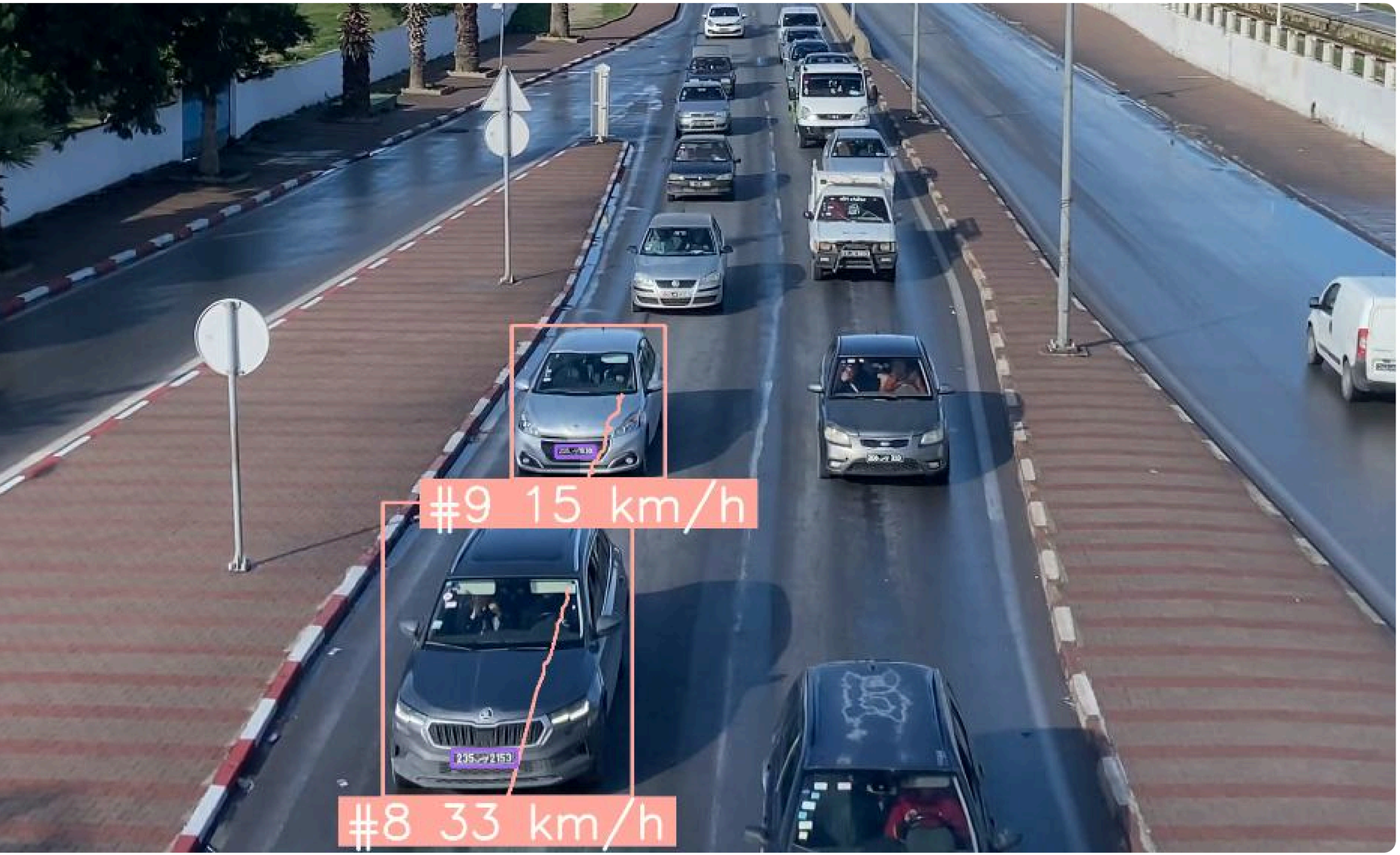
Best Right Threshold Image /

Detected License Plate Numbers:
{'left': 229, 'right': 5180}

License Plate Reading Metrics.

```
0: 384x640 6 cars, 155.4ms
Speed: 4.1ms preprocess, 155.4ms inference, 1.5ms postprocess per image at shape (1, 3, 384, 640)
Car Detection Confidence: 0.7142251133918762
Car Detection Confidence: 0.6554432511329651
Car Detection Confidence: 0.6083932518959045
Car Detection Confidence: 0.5469515323638916
{'inference_id': 'd4155ad9-890f-4731-a3c1-d233ebb5ee84', 'time': 0.05277970300085144, 'image': {'width': 304, 'height': 383}, 'predictions': [{'x': 158.0, 'y': 339.0, 'width':
License Plate Confidence: 0.7315399646759033
{'inference_id': 'e2d85176-e062-43e5-a4c8-92a4376a7412', 'time': 0.05081348400017305, 'image': {'width': 284, 'height': 406}, 'predictions': [{'x': 122.5, 'y': 363.0, 'width':
License Plate Confidence: 0.7319368124008179
```

Speed, License Plate, Car Reading Metrics



Deployment

To use the system, users need to:

1. Input a video of cars.
2. Specify source and target polygon parameters for perspective correction to ensure accurate speed estimation.

The model processes the video and generates an output video with:

- Detected cars highlighted.
- License plates identified.
- Estimated vehicle speeds displayed.

Integration Problem

Explanation:

We developed a model to detect speed, cars, and license plates from video footage.

We also developed a separate model to read license plates(Tunisian and others).

We encountered issues during the integration of these models.

The challenge is in combining car and license plate detection with the license plate reading system.

This integration problem causes difficulties in achieving smooth and accurate output when both models work together.

Thank You!