# License Plate Recognition (LPR)

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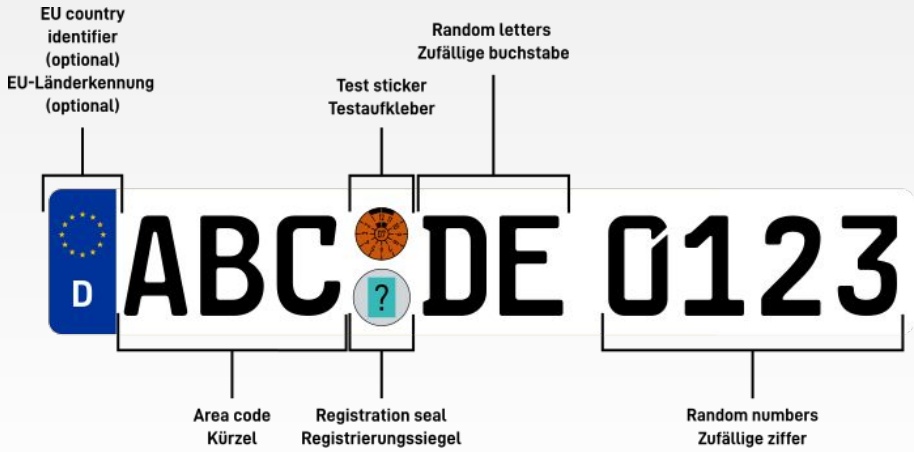
# Introduction

- Vehicle identification is vital for road safety, traffic management, and law enforcement.
- **Automatic License Plate Recognition (ALPR)** systems enable real-time, reliable license plate recognition despite challenges like lighting and angles.
- The study, *"Towards End-to-End Car License Plate Location and Recognition in Unconstrained Scenarios,"* presents a deep learning model designed for accurate and robust license plate detection and recognition in complex scenarios.
- Our project focuses on developing an LPR model for English plates in European regions.


# Problem Statement

- Traditional license plate recognition systems face challenges in poor lighting, adverse weather, angled views, and diverse plate designs.
- This **project aims** to develop a deep learning-based system to localize and recognize license plates across EU countries, addressing variations in formats, fonts, and alignments.
- **Limitations** include reduced accuracy with severely damaged or obscured plates and insufficient region-specific training data.



# Literature Review

1. **"Towards end-to-end car license plate location and recognition in unconstrained scenarios,"**
   **Authors:** Qin and S. Liu,
   **Date:** Jun. 2021
   **Doi:** https://doi.org/10.1007/s00521-021-06147-8

2. **"An Ultra-Fast Automatic License Plate Recognition Approach for Unconstrained Scenarios,"**
   **Authors:** X. Ke, G. Zeng, and W. Guo,
   **Date:** May 2023
   **Doi:** https://doi.org/10.1109/tits.2023.3237581.

3. **"License Plate Recognition System Based on Improved YOLOv5 and GRU,"**
   **Authors:** H. Shi and D. Zhao
   **Date:** Jan. 2023
   **Doi:** https://doi.org/10.1109/access.2023.3240439.

# Literature Review

1. This paper proposes a multi-phase approach for license plate recognition. **ResNet-18** with **FPN** is used for feature extraction and fusion, followed by a location network for bounding box detection in unconstrained scenarios. **RoIAlign** crops and resizes license plate boxes, and rectification unwraps feature maps. A CNN-based recognition network with sequence labeling assigns correct labels to characters using five convolutional and two pooling layers.

2. This paper focuses on recognizing license plate numbers and letters in unconstrained scenarios. It uses **YOLOv3-tiny** for license plate detection and feature extraction, followed by the **MRNet** model for recognition with a rectification-free LP network. Data augmentation, including **RndAugment** and **Bi-RandAugment,** enhances training diversity, improving accuracy and generalization.

3. This paper introduces a system for improved license plate detection and recognition. It utilizes **YOLOv5** for detection, enhanced with an **SE block** for feature focus, and **ArcFace** loss to boost recognition accuracy. A **GRU** processes sequential features for stable character recognition. The system achieves high accuracy, evaluated using **mAP**, precision, and recall, delivering a real-time, robust solution.

# Methodology

- Data Indigestion: data cleaning, and preprocessing to make the data suitable for training.
- Deep learning model: deciding whether to leverage pre-existing deep learning models or create a new one.
- Applying CV algorithms.

# Implementation

## Data preparation:

1. Extracting important values from xml files
2. Normalize the images

```
labels_info = member_object.find('bndbox')
xmin = int(labels_info.find('xmin').text)
xmax = int(labels_info.find('xmax').text)
ymin = int(labels_info.find('ymin').text)
ymax = int(labels_info.find('ymax').text)
```

```
img_resized = load_img(img_path, target_size=(224, 224))
img_array = img_to_array(img_resized) / 255.0

xmin, xmax, ymin, ymax = label
normalized_bbox = (
    xmin / w, xmax / w, ymin / h, ymax / h
)
```

# Split the data

1. We split our data into training and testing. We used 80% of our data for training.

```
x_train,x_test,y_train,y_test = train_test_split(X,y,train_size=0.8,random_state=42)
```

```
inception_resnet = InceptionResNetV2(weights="imagenet",include_top=False, input_tensor=Input(shape=(224,224,3)))

headmodel = inception_resnet.output
headmodel = Flatten()(headmodel)
headmodel = Dense(500,activation="relu")(headmodel)
headmodel = Dense(250,activation="relu")(headmodel)
headmodel = Dense(4,activation='sigmoid')(headmodel)


model = Model(inputs=inception_resnet.input,outputs=headmodel)
```

# Preparing the model

1. We are using learning rate of 0.001
2. We are using Adam optimizer

```
model.compile(loss='mse',optimizer=tf.keras.optimizers.Adam(learning_rate=0.001))
model.summary()
```

3. We then ran the model

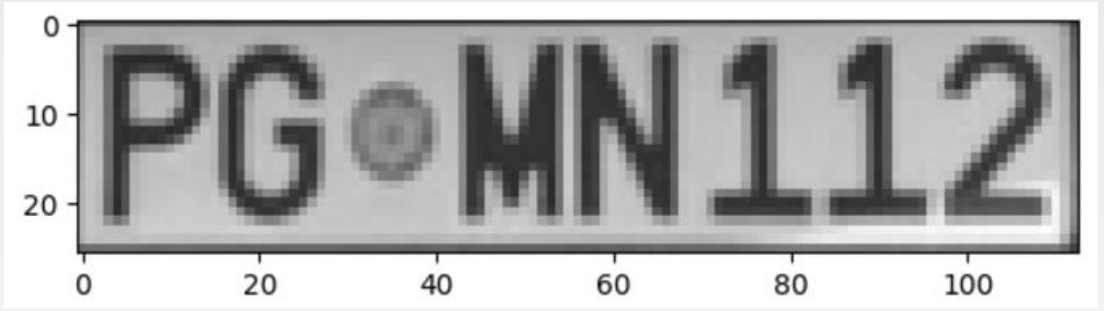
```
tfb = TensorBoard('object_detection')
history = model.fit(x=x_train,y=y_train,batch_size=10,epochs=5,
                    validation_data=(x_test,y_test),callbacks=[tfb])
```

# Extracting the bounding box of plates

1. Save the model and load it
2. call the model to extract the coordinates
3. crop the plate


```
# Make predictions
coords = new_model.predict(test_arr)
# Denormalize the values
denorm = np.array([w,w,h,h])
coords = coords * denorm
coords = coords.astype(np.int32)
xmin, xmax,ymin,ymax = coords[0]
pt1 =(xmin,ymin)
pt2 =(xmax,ymax)
print(pt1, pt2)
cv2.rectangle(image,pt1,pt2,(0,255,0),3)
```

# Another way to do that using CV algorithms

# Recognizing the plate

**What it does**: The `image_to_string` function of `pytesseract` takes an image (in this case, the region of interest or `roi`) as input and uses the Tesseract OCR engine to extract text from it.
**Input**: `roi` (region of interest) is typically a cropped portion of an image containing text (e.g., a license plate, a document, or handwritten text).
**Output**: The recognized text in the form of a string.

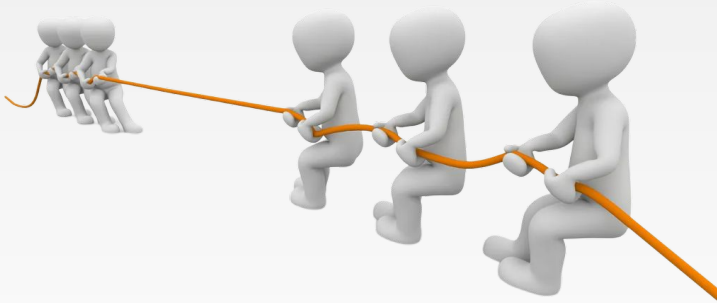
```
text = pt.image_to_string(roi)
print(text)
```

```
PGeMN112
```

# Work Division

- All members collaborated on the code by working together in Google Meet, reviewing and implementing it step by step since it couldn't be divided into separate parts.

- The report and PowerPoint template were shared on Google Drive, allowing everyone to contribute simultaneously.



# Der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