The University of Texas at Arlington

Applied Statistics and Data Science

ASDS-5305-001-DEEP LEARNING/NEURAL NETWORKS

Project Title:

Automatic Number Plate Recognition of Cars (ANPRC)

MISBAHJABIN SHAIKH [1002189629]

JAINY BHATT [1002175002]

VEMANI VENKATESH [1002171480]

1. Problem Statement

The project aims to create an automated system for recognizing car number plates from images or videos. The system should function in diverse environments, handling challenges such as:

- Different lighting conditions
- Various plate formats
- Noisy, occluded, or motion-blurred images

2. Dataset Overview

The dataset includes 453 images in JPEG and XML formats. The images consist of cars with visible license plates.

3. Data Preprocessing

The preprocessing involved cleaning and augmenting data to ensure better model performance. This included annotating images to highlight license plates for training the model.

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Total annotations: 225
Training annotations: 180
Validation annotations: 45
```

As shown in above figure we have 225 total annotations, that we have divided in 180 for training and 45 for validation.

	filepath	height	width	xmin	xmax	ymin	ymax
0	/content/images/N38.jpeg	768	1024	397	645	590	641
1	/content/images/N193.jpeg	615	802	274	502	2	59
2	/content/images/N112.jpeg	344	500	179	347	256	290
3	/content/images/N218.jpeg	332	500	176	301	212	238
4	/content/images/N73.jpeg	190	265	124	209	102	130

The figure above shows the pixel address of detected licence plate co-ordinates in the image.

Before and After annotation:

Below we have shown the original image on the left and the annotated licence plate on the right.

4. Model Building

The **Inception ResNetV2** model was used to detect and recognize text on license plates.

Key Features of Inception ResNetV2:

1. **Inception Modules**
   - Efficiently processes features at multiple scales by combining convolution operations with different kernel sizes in parallel.
2. **Residual Connections**
   - Inspired by ResNet, these connections help avoid the vanishing gradient problem, making it easier to train very deep networks.
   - They allow information to bypass certain layers, improving the flow of gradients during backpropagation.
3. **High Accuracy**
   - Inception ResNetV2 offers high accuracy for detecting patterns in complex images, such as those with noise or occlusions.
4. **Pre-trained Weights**
   - The model can leverage pre-trained weights from large datasets like ImageNet, reducing training time and improving performance on smaller datasets.

Testing Model:

Image tensor shape: torch.Size([3, 729, 901])

5. Testing Results
The model was tested on new images, showing the ability to identify license plate text with varying confidence levels. Example outputs:
- Detected Text: *KL 51* (Confidence: 0.87)
- Detected Text: *K* (Confidence: 0.59)
- Detected Text: *4999* (Confidence: 0.42)

```
Detected text: KL 51 (Confidence: 0.87)
Detected text: K (Confidence: 0.59)
Detected text: 4999 (Confidence: 0.42)
```

6. Conclusions
The model effectively identifies license plate text, although confidence levels vary depending on the text components and image conditions.

References:
Dataset:
https://www.kaggle.com/datasets/aslanahmedov/number-plate-detection
Record Link:
https://mavsuta-my.sharepoint.com/:v:/g/personal/jkb5002_mavs_uta_edu/EfRV7l8HE_1GpVG5RRx3RicB6tnEKKOvcLt7OGCHcOdAIQ?e=7e5h6s