OBJECT DETECTION USING FASTER R-CNN

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PROBLEM STATEMENT

Object detection is a task that involves identifying and locating objects within a image and plays a critical role in various applications.

Challenge

- To accurately and efficiently detect and classify objects from diverse categories

This project addresses the challenges by utilizing Faster R-CNN and evaluating the model's effectiveness in detecting a wide variety of objects

State-Of-The-Art

Traditional methods:

- **HOG and SIFT were used for task like Object Detection. However, these rely on hand-crafted features and are computationally expensive.**

- **These challenges made features like object detection inaccessible**

Why Object Detection using Faster R-CNN

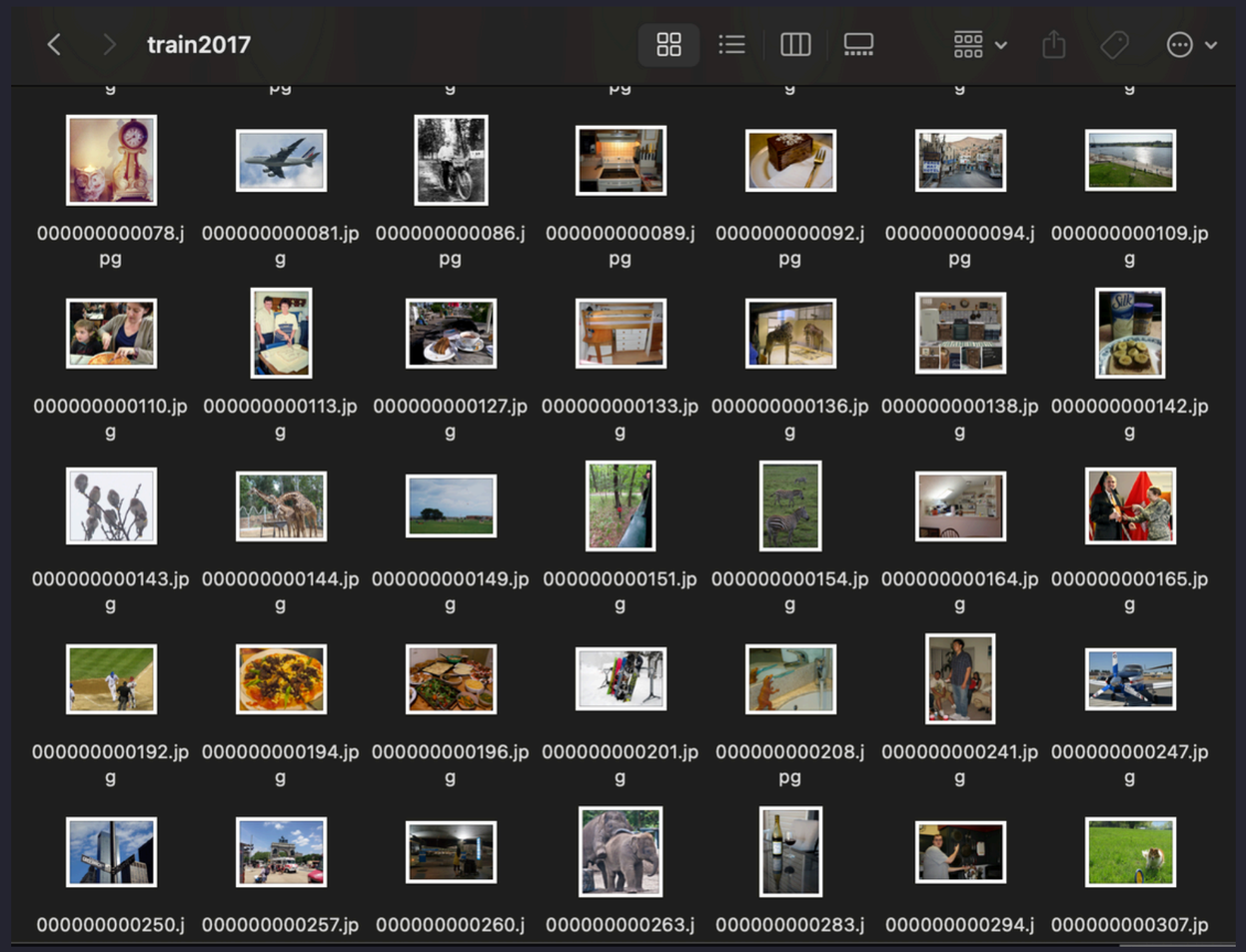
Benefits:

- Efficient
- Accurate, real-time object detection
- Classification
- Localization using bounding boxes
- Handles complex scenarios like occlusion and varying scales.
- First proposes potential object regions and then classifies those regions

MS COCO dataset

- Microsoft Common Objects in Context
- Over 330,000 images and 1.5 million object instances
- 80 object categories
- Annotations:Bounding boxes,segmentation masks, and keypoints

cocodataset.org



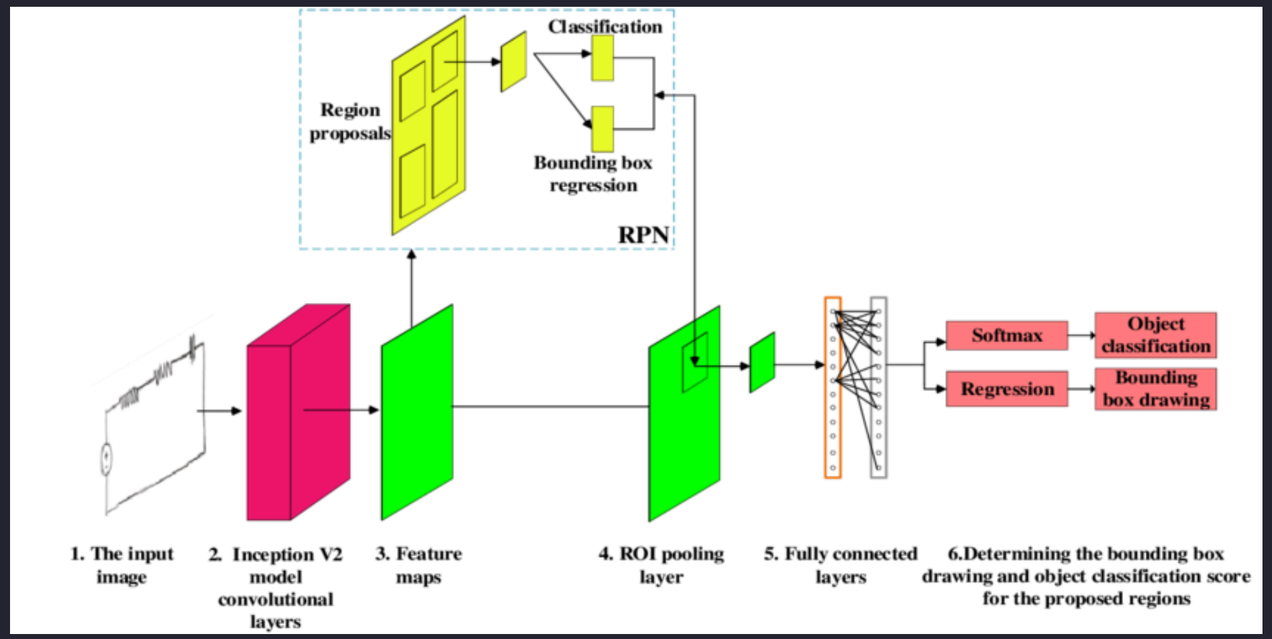
Approach

Preprocessing:

Images are converted into tensors. Normalized using ImageNet mean and standard deviation values.

Model:

Used Faster R-CNN with a ResNet-50 backbone for feature extraction.



There are three parts of a faster R-CNN model:

- Region Proposal Network (RPN)
- ROI Align
- ROI head

Approach

Optimizer:

SGD optimizer with a learning rate of 0.00125, momentum of 0.9, and weight decay of 0.0005.

Learning Rate Scheduler:

StepLR scheduler reduced the learning rate by a factor of 0.1 every 8 epochs.

Training:

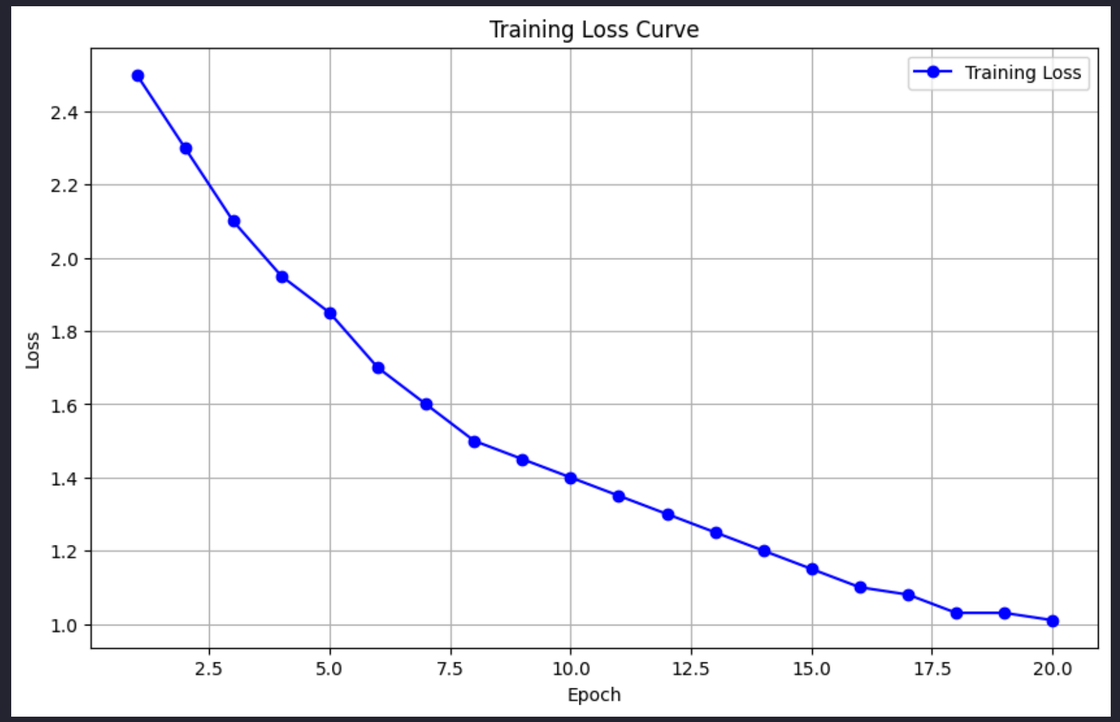
The model was trained for 20 epochs and the loss was computed over batches of data.

Evaluation Metrics:

- Precision
- Recall
- F1 score
- mAP (mean average precision)

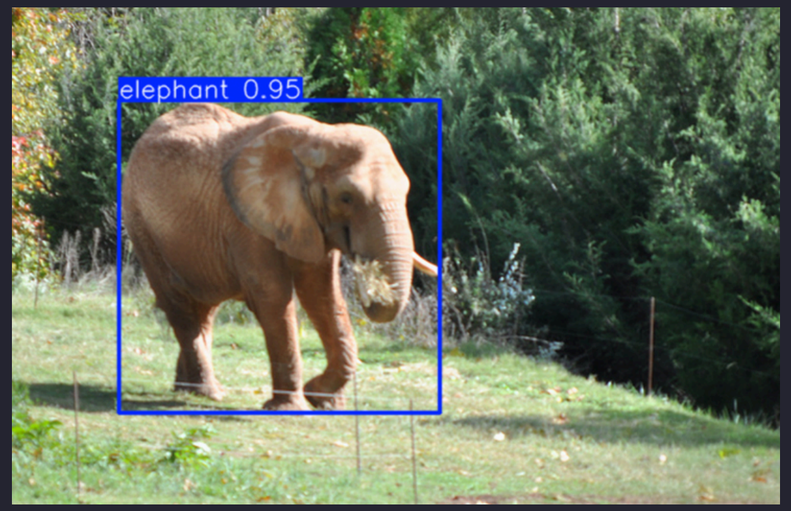
Results

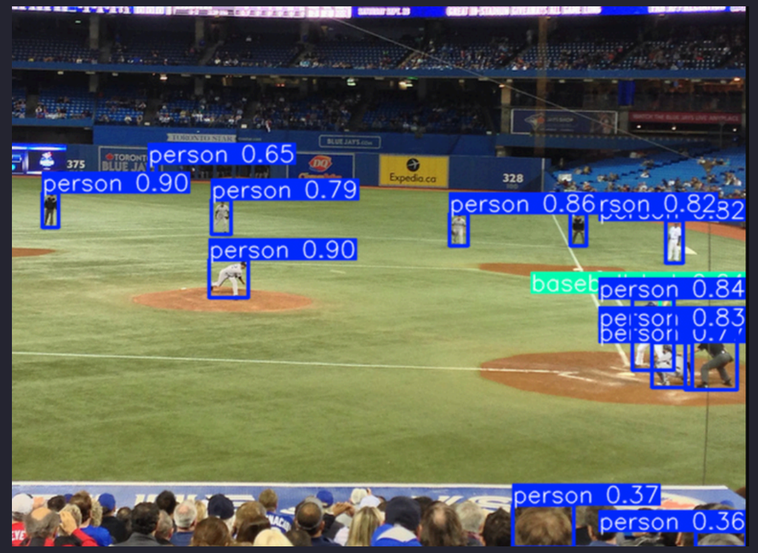
- **Precision**: 0.78
- **Recall**: 0.81
- **F1 Score**: 0.79
- **mAP**: 0.65

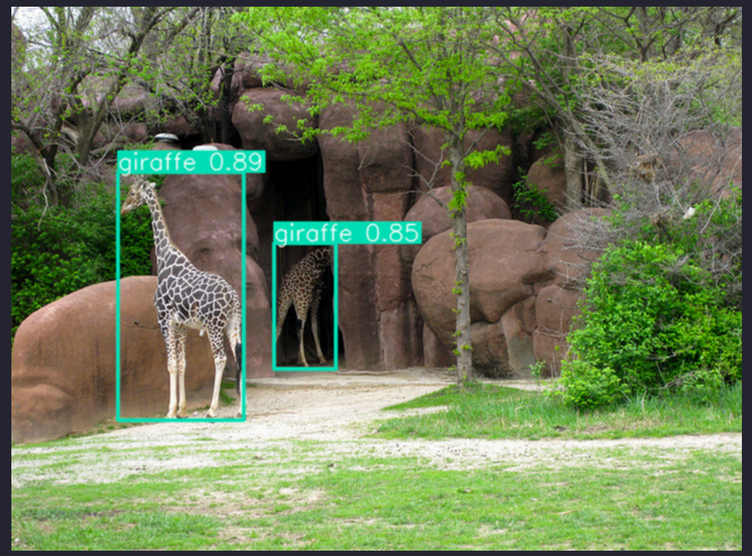


Training Loss Curve Shows the decrease in loss over 20 epochs, indicating effective learning and model convergence.

Object Detection on Test Images







Conclusion

- Successfully trained and evaluated Faster R-CNN on the MS COCO dataset
- The model was able to detect a wide range of objects, but there is room for improvement in handling small or occluded objects.
- Visualized detection results showing the model's ability to localize and classify objects in images.

Future Work

Further fine-tuning and optimization for real-time performance

Exploring alternative models such as YOLO or SSD for comparison in terms of speed and accuracy.

THANK YOU!