

# Small Object Detection Using Deep Learning

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# Introduction

- Small object detection is a challenging task in computer vision.
- Deep learning-based detectors perform well on medium and large objects.
- Performance drops significantly for tiny objects.
- YOLO (You Only Look Once) is a real-time object detection framework.
- This project improves small object detection using YOLO and SAHI.

# Problem Statement

- High-resolution images are resized before inference.
- Small objects lose important visual details.
- Tiny objects occupy very few pixels.
- Standard YOLO struggles with such objects.
- Improvement is needed without retraining the model.

# Objective

- Study small object detection using deep learning.
- Train a YOLOv11 object detection model.
- Perform standard YOLOv11 inference.
- Apply SAHI (Slicing Aided Hyper Inference).
- Compare YOLOv11 vs YOLOv11 + SAHI.

# Dataset

- Dataset prepared in COCO format.
- Dataset obtained using Roboflow.
- Annotated images for object detection.
- Split into training, validation, and testing sets.

# Technologies Used

- Programming Language: Python
- Deep Learning Framework: PyTorch
- Object Detection Model: YOLOv11
- Dataset Tool: Roboflow
- Small Object Enhancement: SAHI (Slicing Aided Hyper Inference)
- Platform: Google Colab

# Methodology

- ① Dataset preparation using Roboflow.
- ② Training YOLOv11 with pre-trained weights.
- ③ Standard YOLOv11 inference.
- ④ Image slicing using SAHI.
- ⑤ Inference on sliced images.
- ⑥ Merging predictions using Non-Maximum Suppression (NMS).

# Results

- YOLOv11 detected objects effectively.
- Limited performance for very small objects.
- YOLOv11 + SAHI detected more small objects.
- Improved localization and visibility.
- Visual results confirmed improvement.

# YOLOv11 vs YOLOv11 + SAHI

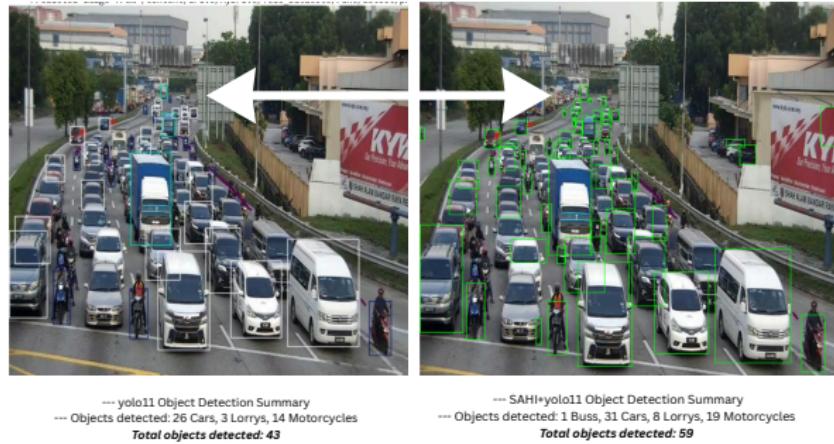


Figure: comparison on traffic places

## YOLOv11

- Total objects detected: 43

## YOLOv11 + SAHI

- Total objects detected: 59

**Inference:** SAHI improves detection of small and dense objects.

## Future Scope

- Useful in identifying tiny objects that create big problems in real-world scenarios.
- Missing small objects can lead to serious safety and operational issues.
- Applications include surveillance, traffic monitoring, and autonomous systems.
- Effective for drone and satellite imagery analysis.
- Can be extended to medical imaging for detecting small but critical anomalies.
- Further optimization can improve inference speed and accuracy.

# Conclusion

- Small object detection is challenging.
- YOLOv11 was trained on a COCO dataset.
- Standard YOLO struggled with tiny objects.
- SAHI significantly improved detection.
- Slicing-based inference works without retraining.

# Thank You