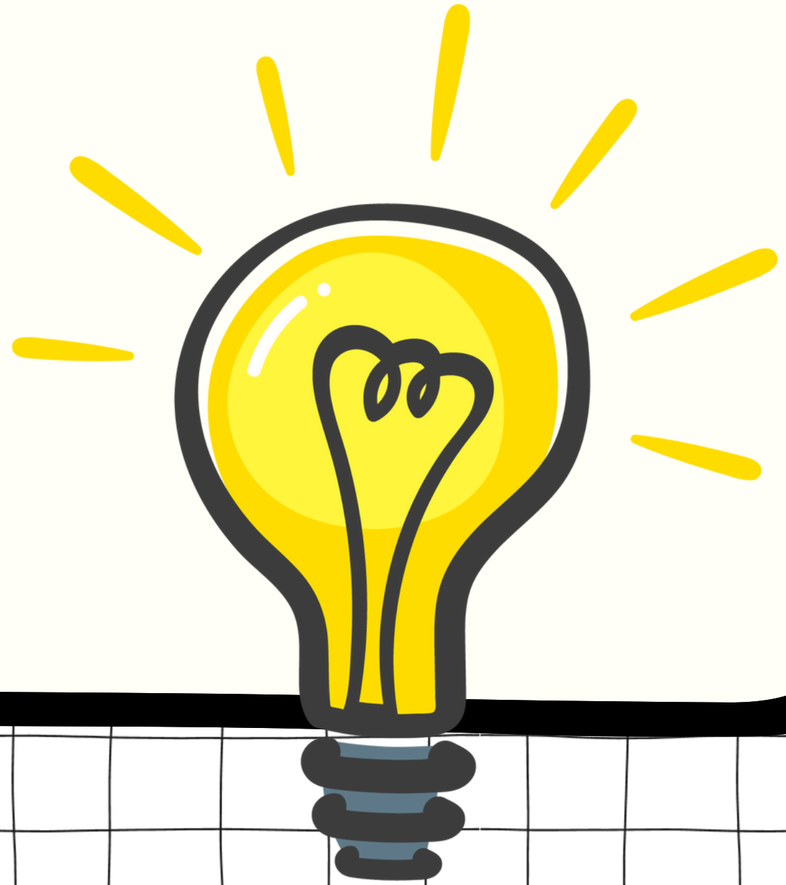
Speed and Distance detection using latest YOLO Models



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Contents

Introduction

Using the latest YOLO models (e.g., YOLOv8, YOLO-NAS), we can detect objects, estimate their distance, and calculate speed by tracking movement across frames.

1️⃣ Detect Objects – YOLO identifies objects in real-time.

2️⃣ Estimate Distance – Using object size & camera calibration.

3️⃣ Calculate Speed – Track object movement across frames.

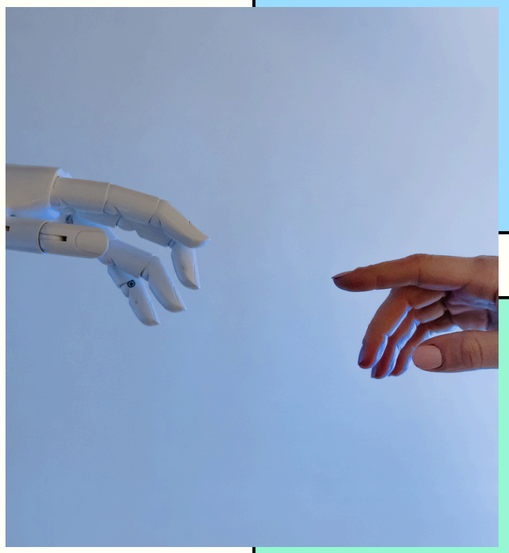
Problem

challenges

01 Accurate Speed Measurement – Traditional radar-based methods can be costly or inaccurate in certain conditions.

02 Real-Time Object Tracking – Ensuring smooth and precise tracking across frames for speed estimation.

03 Distance Estimation Without Sensors – Relying on camera-based depth estimation instead of LiDAR or radar.



Solution

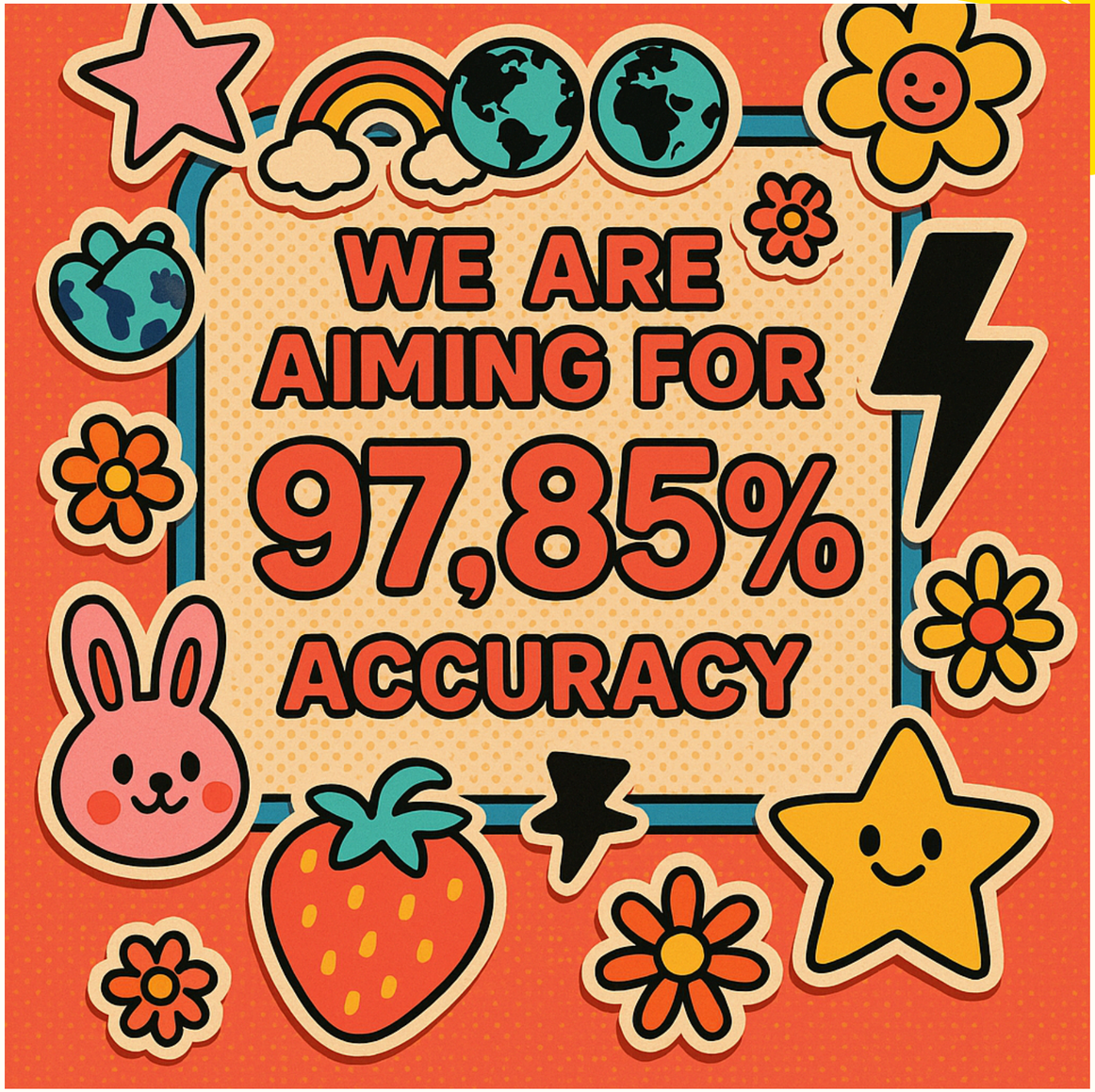
Our solution leverages the latest YOLO models (YOLOv8/YOLO-NAS) for real-time object detection, combined with SORT/DeepSORT for robust tracking across frames. We estimate object distance using monocular depth estimation and camera calibration, eliminating the need for additional sensors like LiDAR. Speed is computed by tracking movement over time using FPS-based calculations. To ensure reliability in challenging conditions, we enhance low-light performance with AI-powered image processing. The system is optimized for edge devices like etson Nano & Raspberry Pi, enabling efficient real-world deployment for applications in traffic monitoring, autonomous driving, and sports analytics. 🚀

Software Requirements

- ✅ Programming Language– Python (preferred for AI/ML and computer vision).
- ✅ Deep Learning Framework – PyTorch or TensorFlow for YOLO model inference.
- ✅ YOLO Model – YOLOv8/YOLO-NAS for object detection.
- ✅ Tracking Library – SORT/DeepSORT for object tracking.
- ✅ Computer Vision– OpenCV for image processing and video handling.
- ✅ Mathematical Computations – NumPy for numerical operations.
- ✅ Hardware Acceleration – CUDA (for NVIDIA GPUs) or OpenVINO (for Intel accelerators).

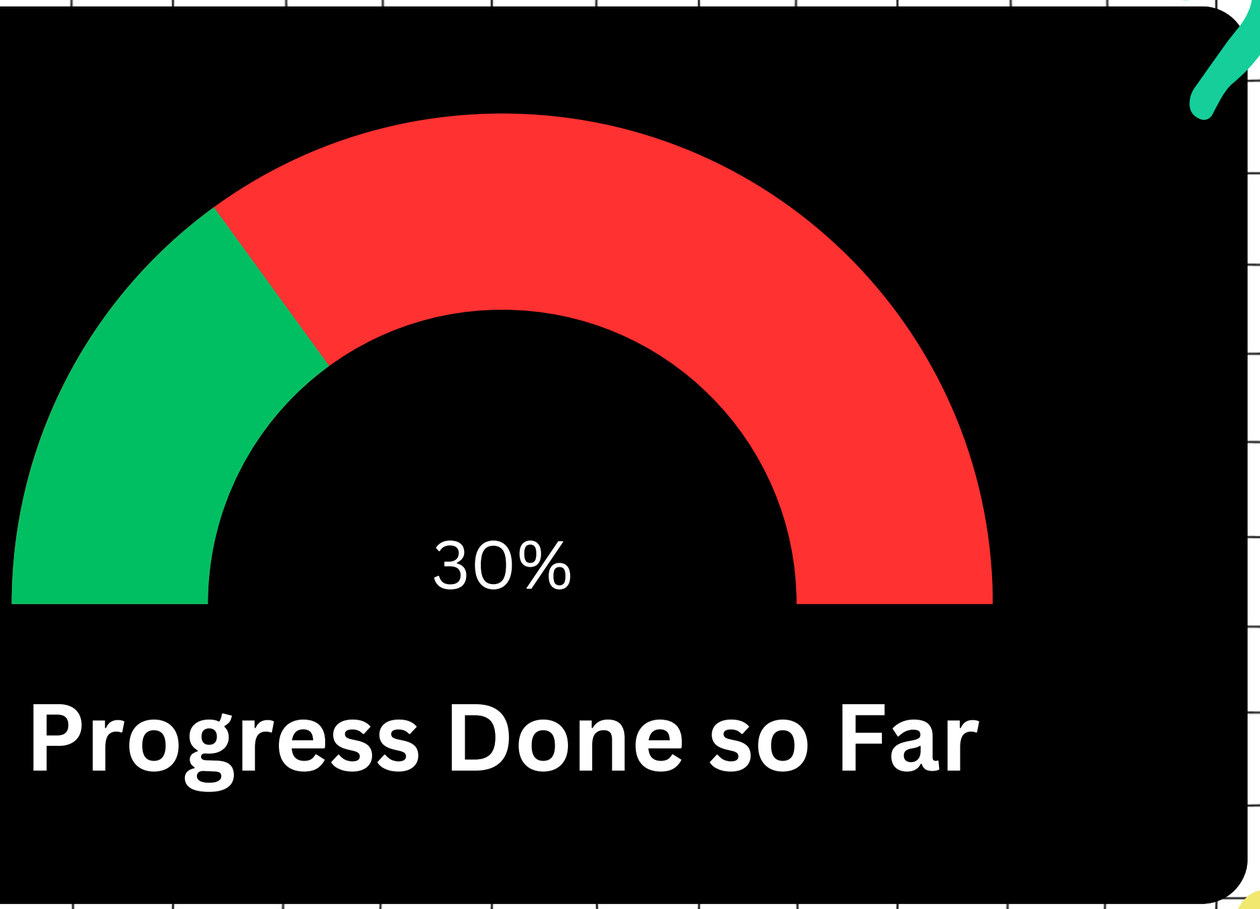
Facts

- ✅ Real-Time Processing – YOLO models can process up to 120 FPS, enabling instant detection.
- ✅ High Accuracy – YOLOv8 achieves over 50+ mAP on COCO datasets, ensuring precise detection.
- ✅ Sensor-Free Distance Estimation – Uses camera-based techniques instead of LiDAR or radar.
- ✅ Multi-Object Tracking – Can track multiple moving objects simultaneously with DeepSORT.



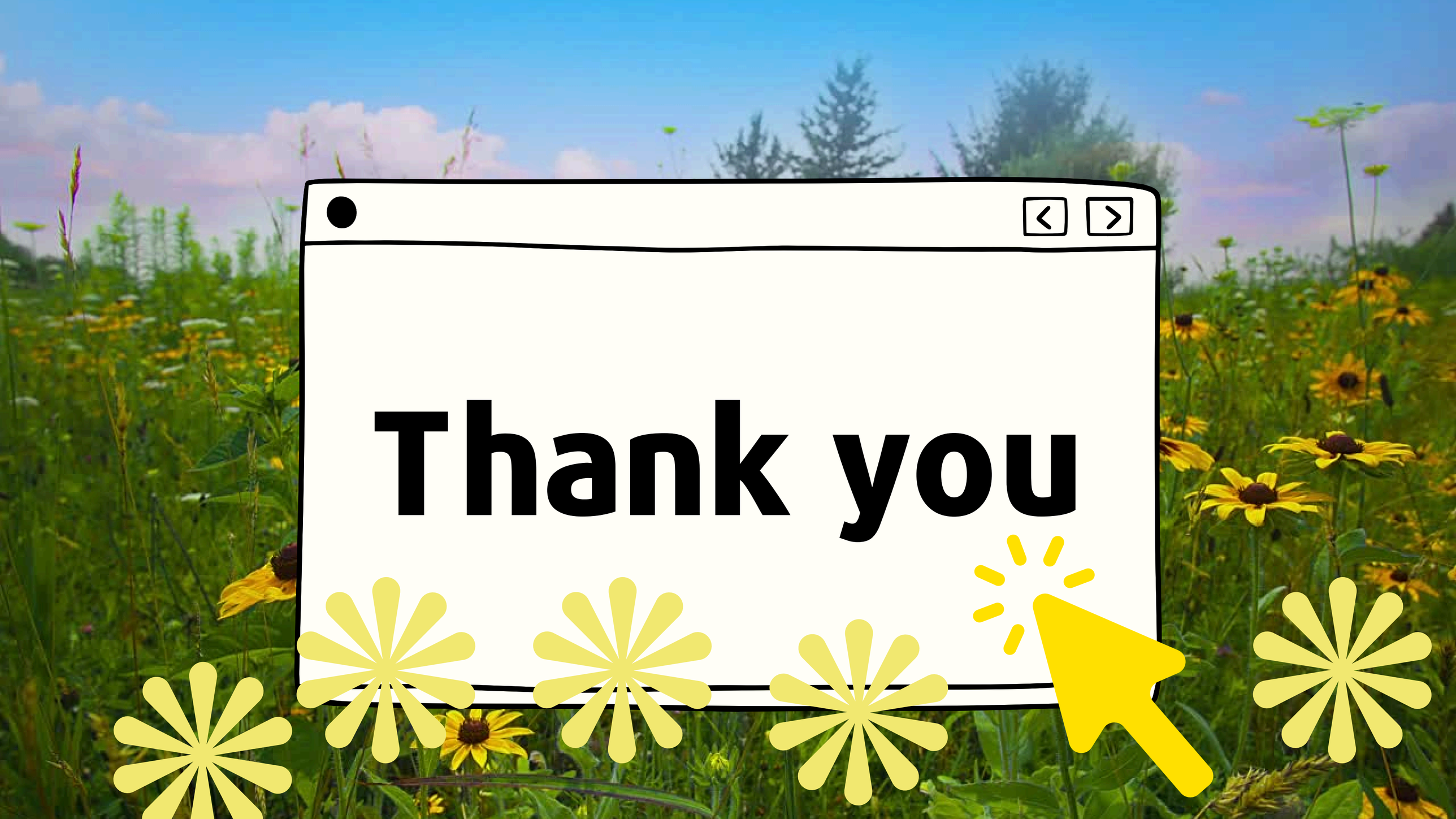
Work done so far

We have successfully integrated YOLOv8/YOLO-NAS for real-time object detection and implemented SORT/DeepSORT for multi-object tracking. The system is capable of estimating object distance using monocular depth estimation and camera calibration techniques. Speed calculation is achieved by tracking object displacement across frames, leveraging FPS-based time measurements.



References

Our work is based on advancements in computer vision and deep learning, primarily leveraging YOLOv8/YOLO-NAS for object detection, as referenced from the official Ultralytics documentation and research papers on YOLO architectures. For object tracking, we rely on SORT/DeepSORT, originally introduced in Wojke et al.'s multi-object tracking paper. Distance estimation techniques are inspired by monocular depth estimation methods commonly used in autonomous driving research. 🚀


Thank you