

Sub-Object Detection using YOLOv8

Detecting and classifying objects and their sub-objects in videos using YOLOv8

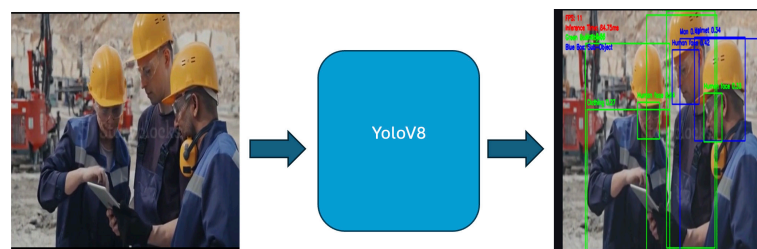
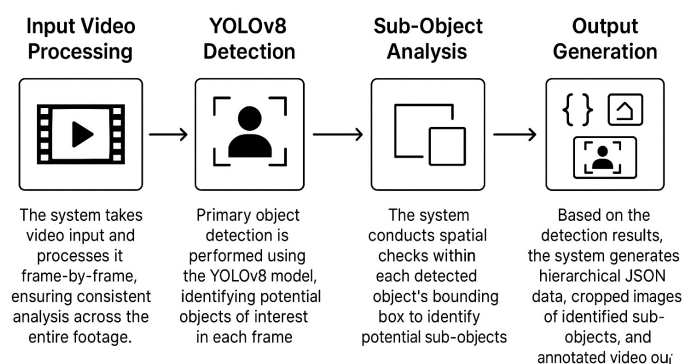
INTRODUCTION

In complex environments, detecting only the main object is not enough. Sub-Object Detection identifies both parent objects (e.g., Car, Worker, Machine) and their associated sub-objects (e.g., License Plate, Helmet, Valve) to enable deeper scene understanding. This system is built for real-time, efficient processing even on low-resource devices.

OUR GOAL

To develop a real-time sub-object detection system that identifies both objects and their components, enabling deeper scene analysis and intelligent decision-making across multiple domains.

PROCESSING PIPELINE



FPS: 16
Inference Time: 59.92ms
Green Box: Object
Blue Box: Sub-Object

Object	Confidence	Subobjects
Man	55.99%	['Clothing']
Clothing	50.69%	-
Clothing	49.45%	['Clothing']
Man	45.76%	['Man', 'Clothing', 'Clothing']
Man	42.67%	['Clothing']
Clothing	36.43%	-

FEATURES

- Hierarchical Detection:** Detect objects along with their sub-parts, maintaining parent-child relationships.
- Real-Time Performance:** Achieves 10–30 FPS on CPU, optimized for real-world deployments.
- Lightweight Model:** Fine-tuned YOLOv8n architecture for minimal computational load.
- Structured Outputs:** JSON-formatted detections for easy integration with analytic and monitoring systems.

OPERATING SCENARIOS

- Industrial Safety Compliance:** Detect helmets, gloves, and vests on workers.
- Retail Analytics:** Detect products within racks or packages.
- Surveillance and Security:** Detect concealed objects or gear on individuals.
- Manufacturing Monitoring:** Detect components on machinery in assembly lines.

This project implements a video object detection pipeline using YOLOv8, capable of identifying objects and their sub-objects (e.g., a person inside a car). It draws bounding boxes, saves results as images and JSON, and supports real-time previews.



Project: Sub-Object Detection Research by Jay Dev, Kunal Kumar, Sumit Kumar, Himanshi Singh under the supervision of Dr. Balraj Kumar.

Web Application: sub-obj-detector.streamlit.app

Acknowledgment:

This project is a part of research focusing on enhancing hierarchical object detection capabilities for real-world, real-time applications.

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