# **Real-Time Object Detection and Tracking with YOLOv8**

### **Name: Harshita Gupta Position: ML Intern**

## **1. Performance Metrics**

### **FPS Achieved: Average FPS: 5 FPS (measured with 640x640 input resolution using webcam input)**

## **2. Screenshots**

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## **3. Hardware Configuration**

### **CPU: AMD Ryzen 5 5600H with Radeon Graphics, 3301 MHz, 6 Core(s), 12 Logical Processors**

### **GPU: AMD Radeon(TM) Graphics (ONNX used CPU-only execution)**

### **RAM: 16 GB**

## **4. Key Techniques & Optimizations**

### **The application is containerized using Docker for easy deployment, leveraging a modular architecture for maintainability.**

### **Architectural Decisions:**

### **YOLOv8 ONNX Runtime:**

### **Leveraged ONNX for CPU-optimized inference without GPU dependencies.**

### **Used non\_max\_suppression with class-wise filtering to reduce false positives.**

### **Temporal Consistency:**

### **Kalman Filters: Predicted object trajectories to handle occlusions.**

### **Hungarian Algorithm: Matched detections across frames using a composite cost matrix (IoU, motion, appearance).**

### **Appearance Features:**

### **HSV histogram-based re-identification (reid\_threshold=0.7) for robust tracking across occlusions.**

### **Memory Management:**

### **Object history cleanup every 100 frames to prevent memory bloat.**

### **Confidence decay (-0.05 per frame) to phase out stale tracks.**

### **Optimizations:**

### **CLAHE Preprocessing: Enhanced low-light image quality for better detection.**

### **Batchless Inference: Processed frames individually for low-latency streaming.**

### **Dynamic Alerting: Flashing bounding boxes and alerts for missing objects.**

## **6. Challenges & Improvements**

### **Challenges:**

### **CPU-only inference limited FPS compared to GPU-accelerated setups.**

### **Re-identification accuracy drops in crowded scenes (e.g., success rate ~60% with >10 objects).**

### **Future Work:**

### **Integrate GPU acceleration via CUDA execution providers.**

### **Add multi-threaded video I/O for higher throughput.**

### **Submitted By: Harshita Gupta Date: April 28, 2025**

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