Video-Based Suspicion Score Analysis

RF-DETR vs YOLO Evaluation

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1 Overview

This report analyzes three test videos processed through the GuardCar detection pipeline. The goals of the analysis were:

1. Identify **when each class appears** in the frame.
2. Understand **how object area influences suspicion score**.
3. Compare **suspicion score stability** between the cloud model (RF-DETR) and the fallback model (YOLO).

The following videos were used:

- **IMG_0269**: A person walks forward, then retreats, then leaves.
- **IMG_0270**: A person walks toward the camera and remains near it.
- **IMG_0271**: A person briefly enters the frame, then leaves quickly.

2 Suspicion Score Over Time (RF-DETR)

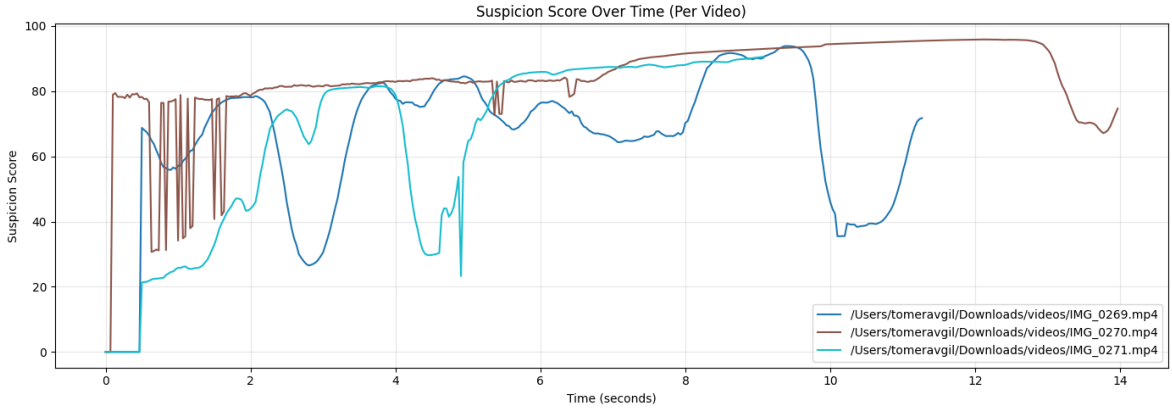

Figure 1: Suspicion Score Over Time for RF-DETR (cloud model).

Observations

- **IMG_0270**: The hypothesis that suspicion remains consistently high when the subject approaches the camera is confirmed. The curve rises smoothly from ≈ 30 to near 100 and remains stable.
- **IMG_0269**: The score increases when the subject moves toward the camera, decreases during retreat, and increases again when approaching.
- **IMG_0271**: Because the subject quickly leaves the frame, the suspicion score rises briefly, then falls sharply.

Model Behavior

RF-DETR produced **smooth, stable suspicion scores**. There is very little noise or oscillation even when movement is fast or partially occluded.

This indicates:

- Stable bounding box predictions
- Consistent class confidence
- Robustness to motion blur and partial detection loss

3 Area Ratio vs Suspicion Score (RF-DETR)

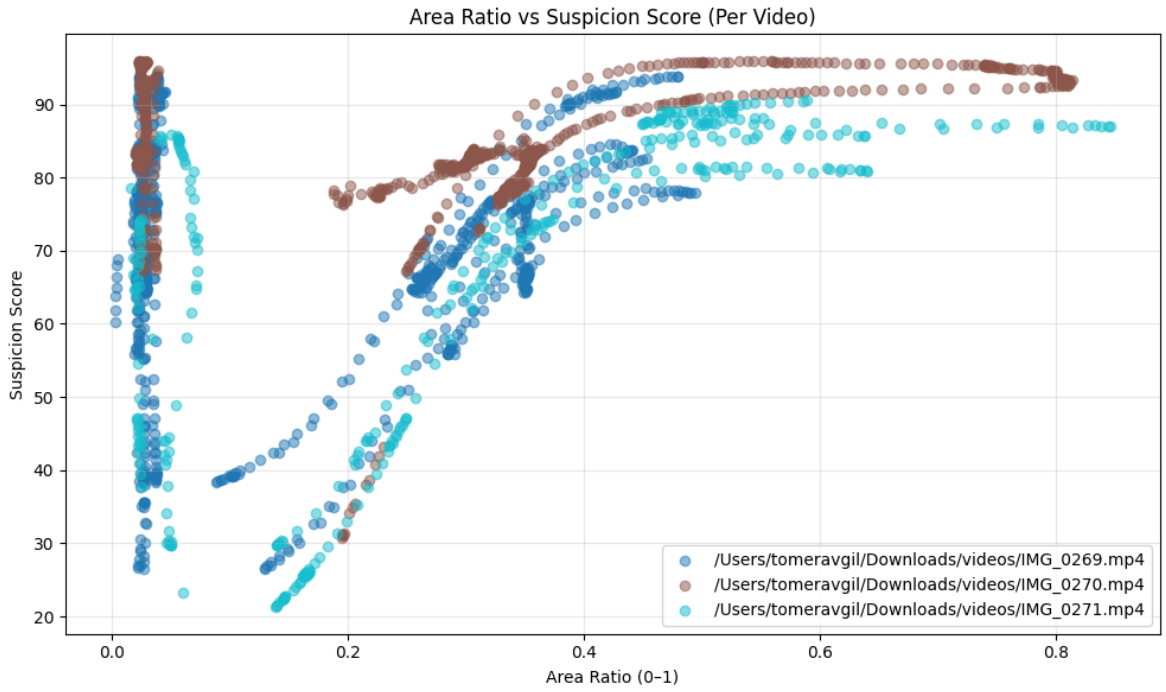

Figure 2: Area Ratio vs Suspicion Score for RF-DETR.

Observations

- Larger area ratios (subjects close to the camera) correspond to higher suspicion scores.
- The relationship is approximately monotonic: as area increases, suspicion score increases as well.
- Across all videos, RF-DETR maintains a consistent interpretation of area → suspicion scaling.

Conclusion

RF-DETR's scoring strongly correlates with subject proximity, supporting the intended design of the suspicion model.

4 YOLO Baseline (Fallback Model)

To compare stability, we also generate the same plots using YOLO detections.

4.1 Suspicion Score Over Time (YOLO)

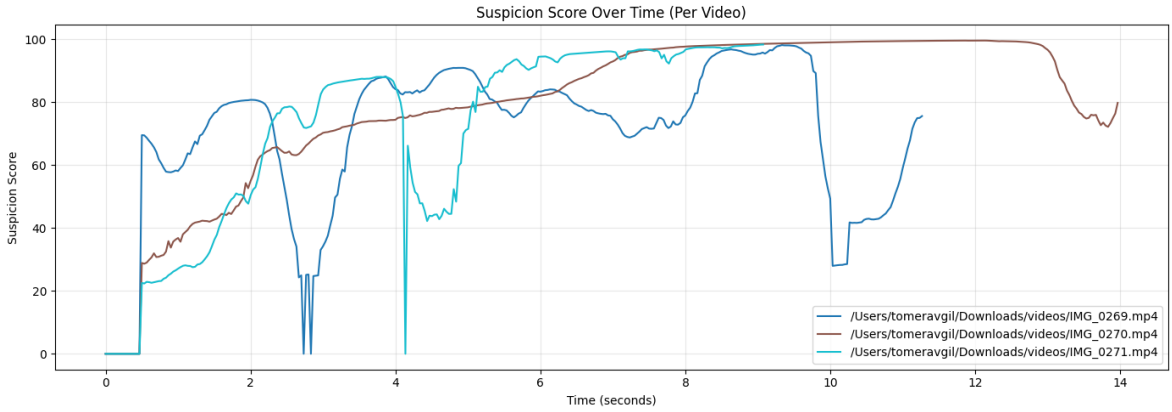

Figure 3: Suspicion Score Over Time using YOLO (fallback model).

Observations

- YOLO scores fluctuate rapidly, especially during motion or occlusion.
- Sharp drops occur even when the subject remains close to the camera.
- This instability is **not present in the RF-DETR results**.

Conclusion

YOLO is significantly more noisy, likely due to:

- More volatile bounding-box predictions
- Occasional missed detections
- Lower temporal consistency

This validates the advantage of RF-DETR for cloud-based inference.

5 Area Ratio vs Suspicion Score (YOLO)

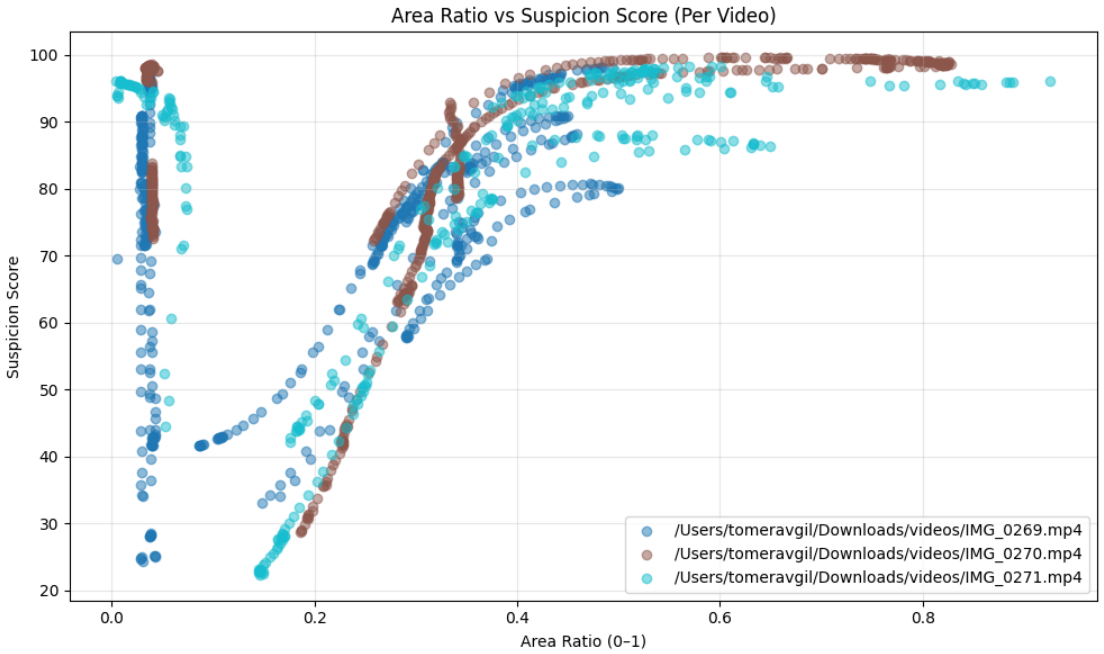

Figure 4: YOLO Area Ratio vs Suspicion Score.

Observations

- The global area-to-suspicion relationship remains similar to RF-DETR:
  - small area → low suspicion
  - large area → high suspicion
- However, the **scatter is much wider**, indicating less consistency.

Conclusion

Even though YOLO's raw predictions fluctuate, the underlying area-based suspicion formula still trends correctly. RF-DETR simply provides better stability and fewer outliers.

6 Final Summary

- **RF-DETR confirmed all hypotheses:** Smooth suspicion scores, predictable area scaling, and reliable temporal behavior.
- **IMG_0270:** Suspicion stays high when a person walks toward the camera — hypothesis validated.

- **IMG_0269:** Suspicion rises and falls as the person moves toward and away from the camera.
- **IMG_0271:** Suspicion increases briefly and drops when the person leaves the frame.
- **YOLO is much more unstable:** Rapid oscillations, inconsistent bounding boxes, and noisy suspicion scores.
- **BUT the area-to-suspicion relationship remains valid in both models.**

RF-DETR provides a more reliable foundation for real-time threat scoring, especially when combined with motion tracking and cloud inference consistency.