# TRAFFIC SIGNS
# MAPPING with GNSS & DL
# in Cambodia

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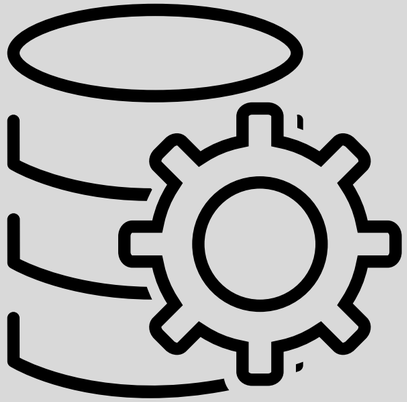
Safety & Inventory
Traditional Method
High-Technology Method
DL & GPS

# Research Gaps



Dataset Limitations
(Zhao et al., 2024)

Lack of Sign Status
(Chen & Ren, 2023)



High-Cost Technologies
(Balado et al., 2020)
(Wang et al., 2010)

Google Street View
(Ning et al., 2025)

Geo-localization
(Wilson et al., 2021)
(Chaabane et al., 2021)

Mapillary

Mapillary.com

# Equipment use

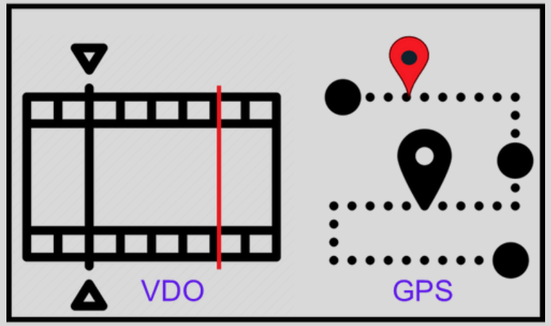
QZNEO


U-blox ANN-MB-00

Any car

# Method Pipeline

CamTSD




Time Difference

Lat, Lon, Name, Status

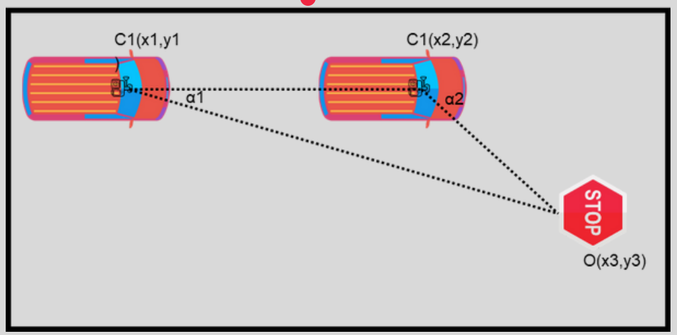
Object Detection, Classification

Object Tracking

Video & GPS Syncing

Object Mapping

ByteTrack
(Zhang et al., 2022)




Pair Fame for Triangulation

## 1.1 Dataset

CamTSD
2,700 images,
10,200 annotations.
RGB, 4K Resolution
JSON, COCO to YOLO Format
80% Train + 20% Val


| | Object | Class | Name | Status |
|---|---|---|---|---|
| 1 | ◉ Traffic Sign | ○ Prohibitory<br>○ Mandatory<br>○ Priority<br>◉ Warning<br>○ Service<br>○ Other Class<br>○ Sign Post | Children Crossing | ◉ Good condition<br>○ Occlusion, Partial, Tree<br>○ Stain, Stickered, Spray<br>○ Colored, Old, Wearing, Scretch<br>○ Damage, Bend,Dent, Tilt, Buried |

Data Annotation with VIA
(Dutta & Andrew 2019)

## 1.2 Model Training

- Convenient , User-friendly & Open-source
- SSD, Quickly & Reasonably Accurate
- Lightweight & Fast


YOLOv8
Jocher et al. (2023)

### 1.2.1 Traffic Signs Detection

| Metric/Argument | Model1 | Model2 | Model3 | Model4 | Model5 |
|---|---|---|---|---|---|
| precision | **0.9601** | 0.97753 | 0.98452 | 0.97524 | 0.97362 |
| recall | **0.95211** | 0.9389 | 0.92806 | 0.92446 | 0.92921 |
| mAP50 | **0.97682** | 0.9787 | 0.9786 | 0.9725 | 0.96897 |
| mAP50-95 | 0.87061 | 0.87471 | 0.88365 | 0.86776 | 0.86728 |
| model | **yolov8n.pt** | yolov8n.pt | yolov8n.pt | yolo11n.pt | yolo12n.pt |
| epochs | **80** | 100 | 120 | 80 | 80 |
| batch | 16 | 16 | 16 | 16 | 16 |
| imgsz | 640 | 640 | 640 | 640 | 640 |

# 1.2.2 Traffic Signs Recognition

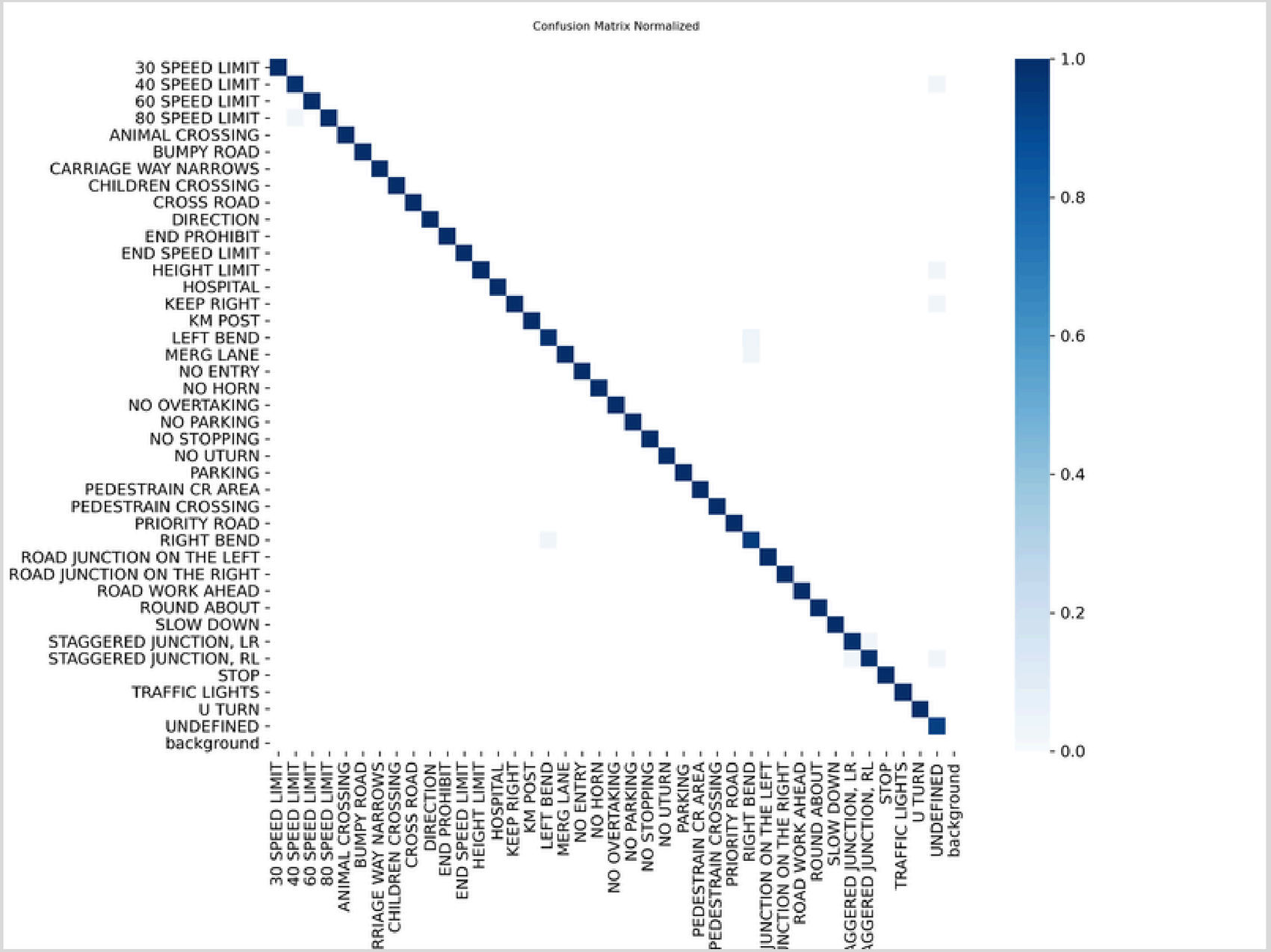
- Augmented in Minor Class

(resize, rotate, affine, blur, rain, sunflare)

- Train: epochs=150, imgsz=64,

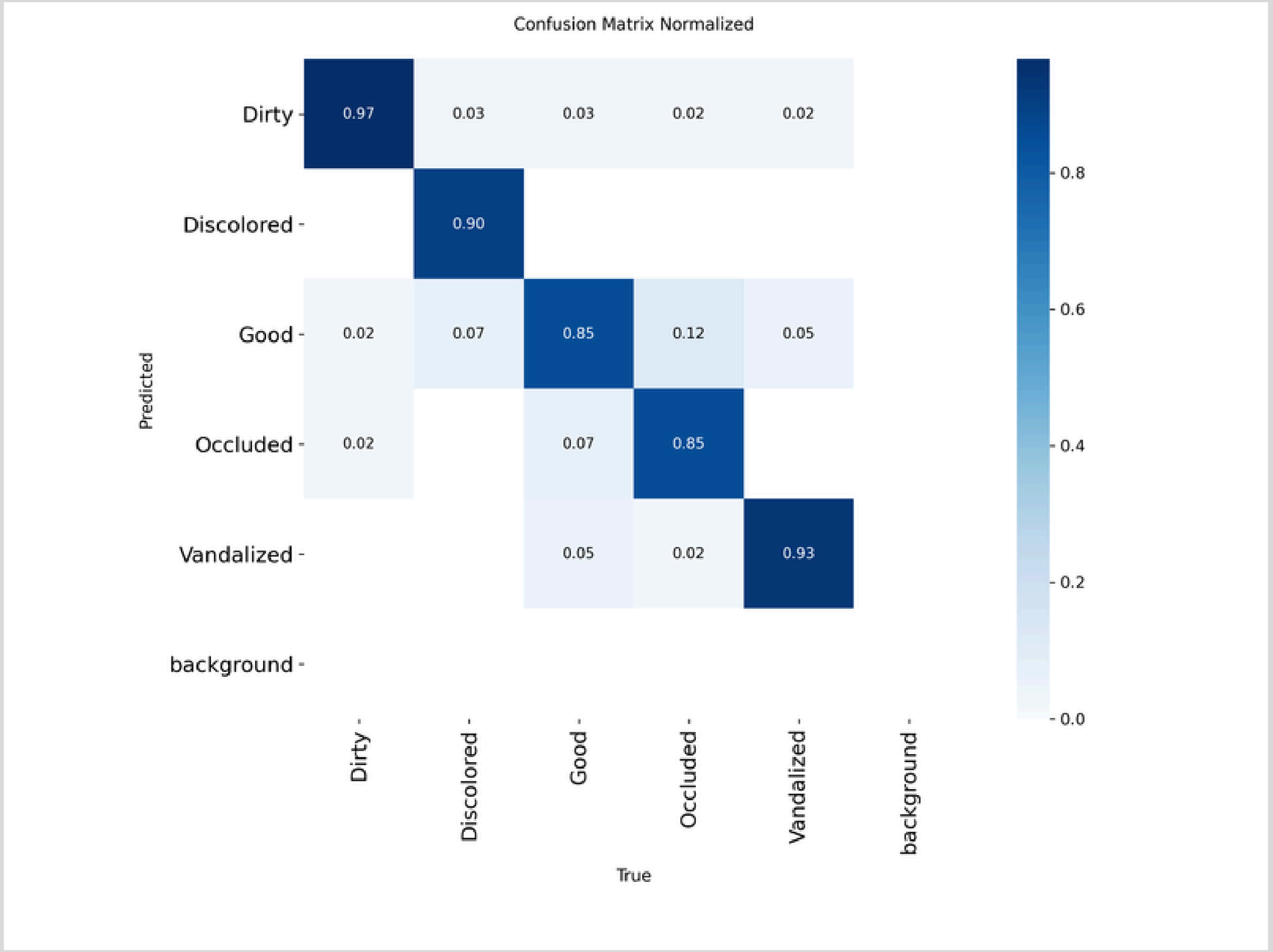
flipud=0.5, fliplr=0.0

- 40 Classes



## 1.2.3 Traffic Signs Status

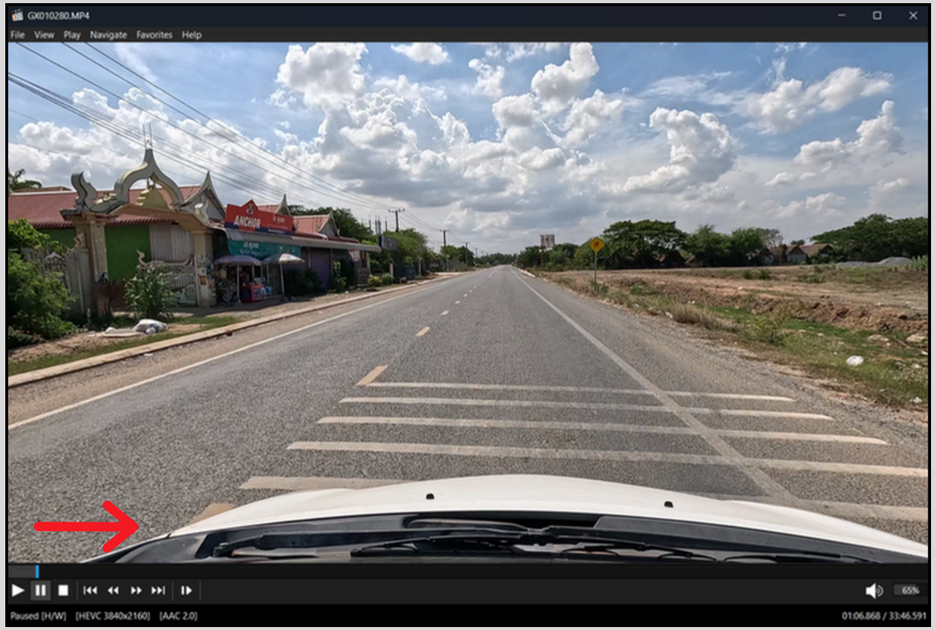
- Augmented
- Train: epochs=150, imgsz=64, hsv_h=0.0, hsv_s=0.0, hsv_v=0.0, degrees=15, translate=0.1, scale=0.5, erasing=0.0, mosaic=0, flipud=0.5, fliplr=0.5, auto_augment= None

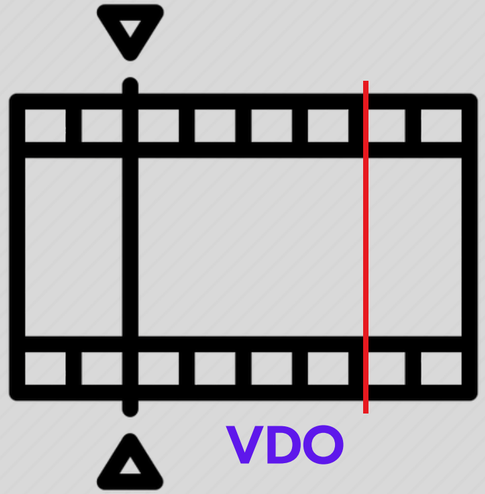



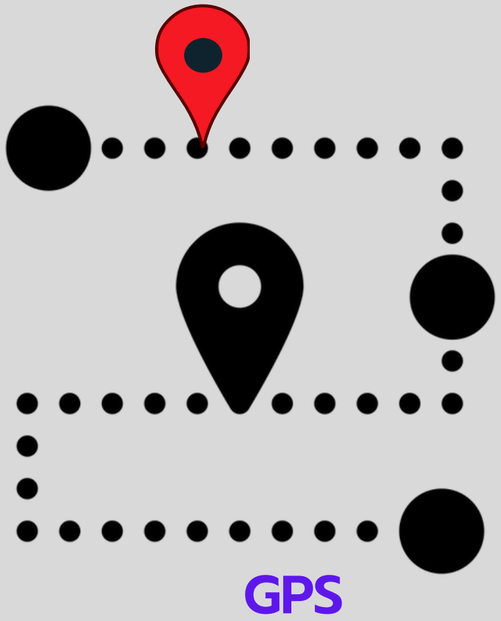
## 2. Object Tracking

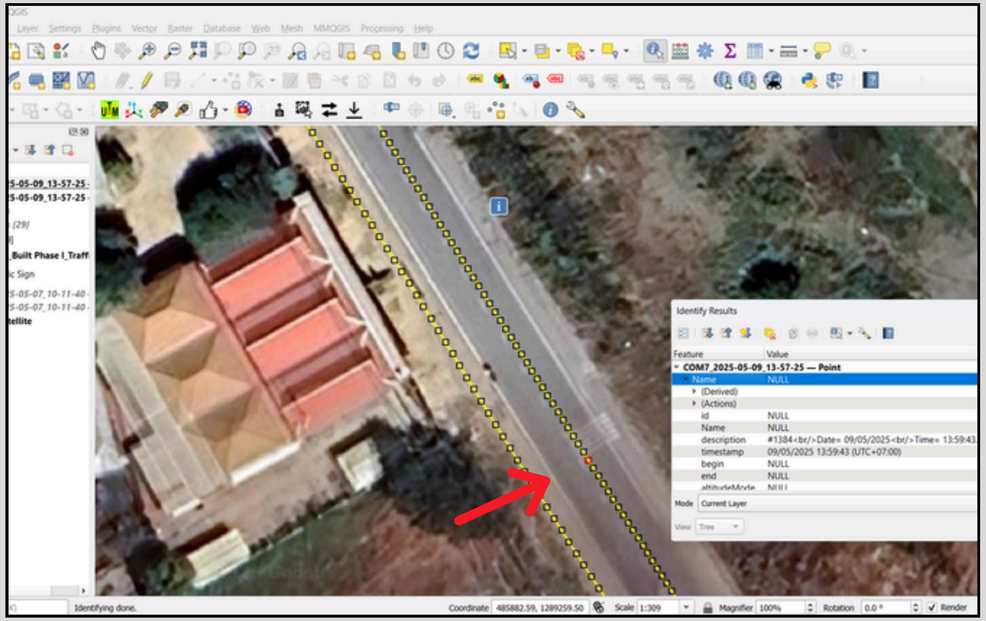
Ultralytics Tracking: ByteTrack (Zhang et al., 2022), Capture Pair Frames

# 3. Video and GPS Synchronized



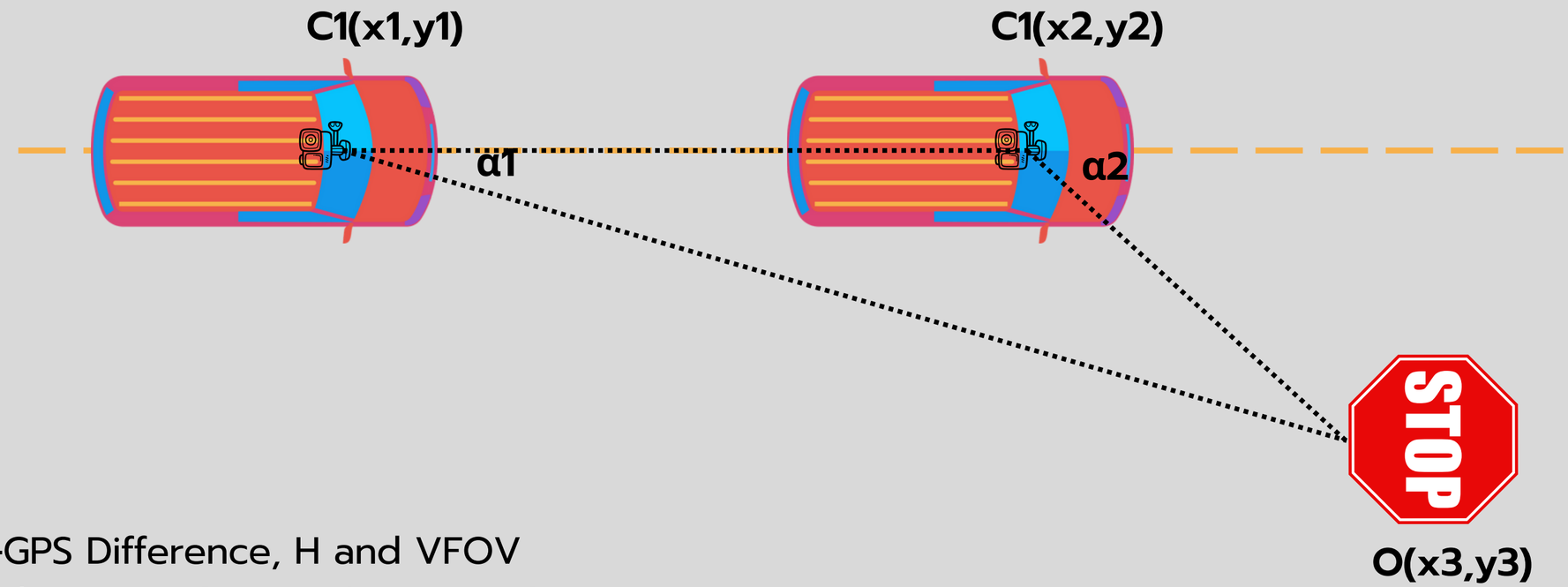




Align GPS & Video

# 4. Triangulation



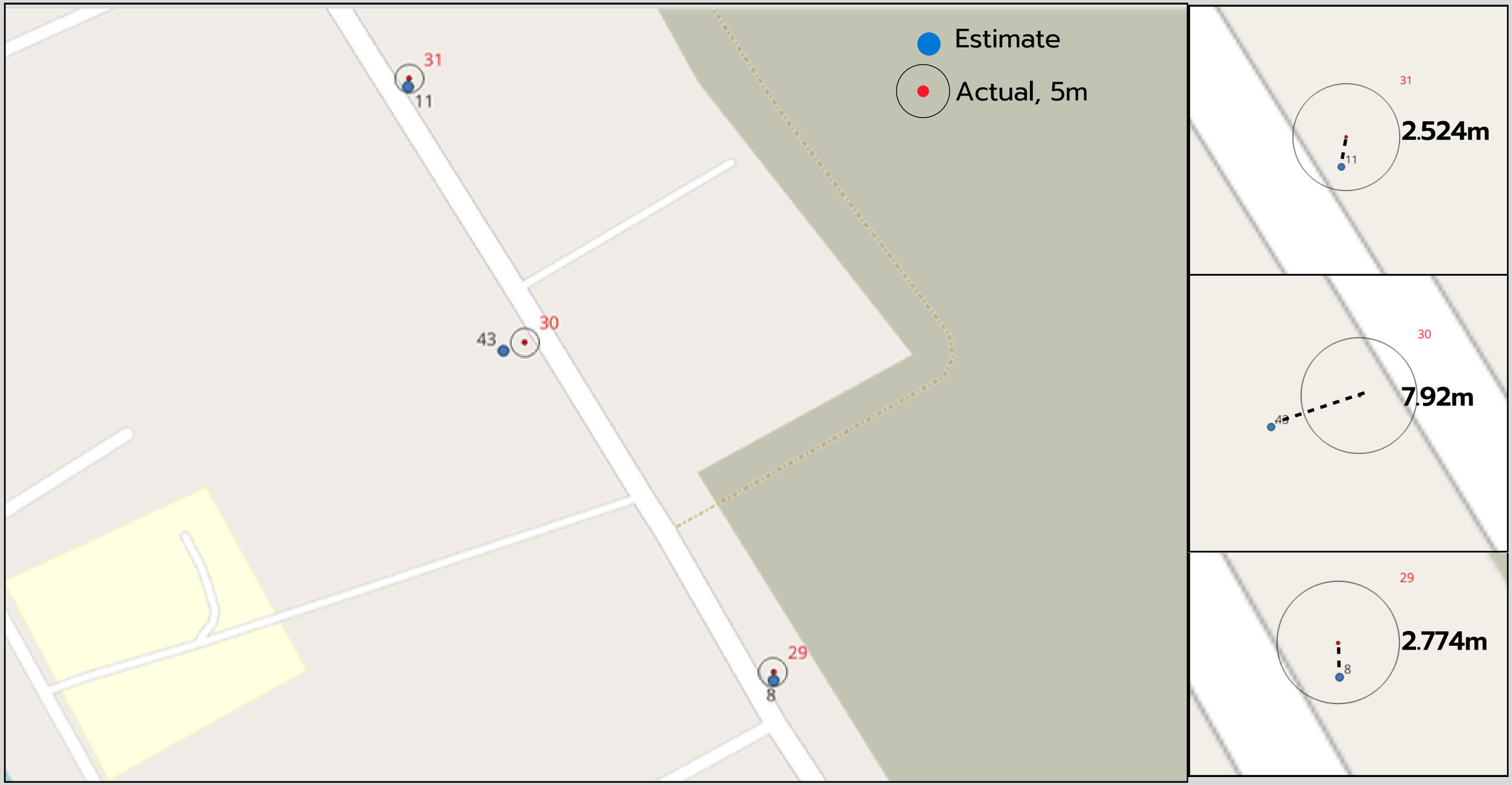

- Camara-GPS Difference, H and VFOV
- Distance between Camera (Haversine)
- Traffic Sign Detection, bbox
- Calculate Camera to obj Distance
- Angel of obj to epipolar
- Calculate obj coordinate

# Results Attributes

| Track ID | Latitude OBJ | Longitude OBJ | *Latitude Act* | *Longitude Act* | *Diff* | Name | Status |
|---|---|---|---|---|---|---|---|
| 8 | 11.66277 | 104.8703 | 11.6628 | 104.8703 | 2.774 | ['CHILDREN CROSSING'] | ['Good'] |
| 11 | 11.66461 | 104.8692 | 11.66463 | 104.8692 | 2.524 | ['ROAD JUNCTION ON THE LEFT'] | ['Good'] |
| 43 | 11.66379 | 104.8695 | 11.66382 | 104.8695 | 7.92 | ['CHILDREN CROSSING'] | ['Good'] |

8 11 43

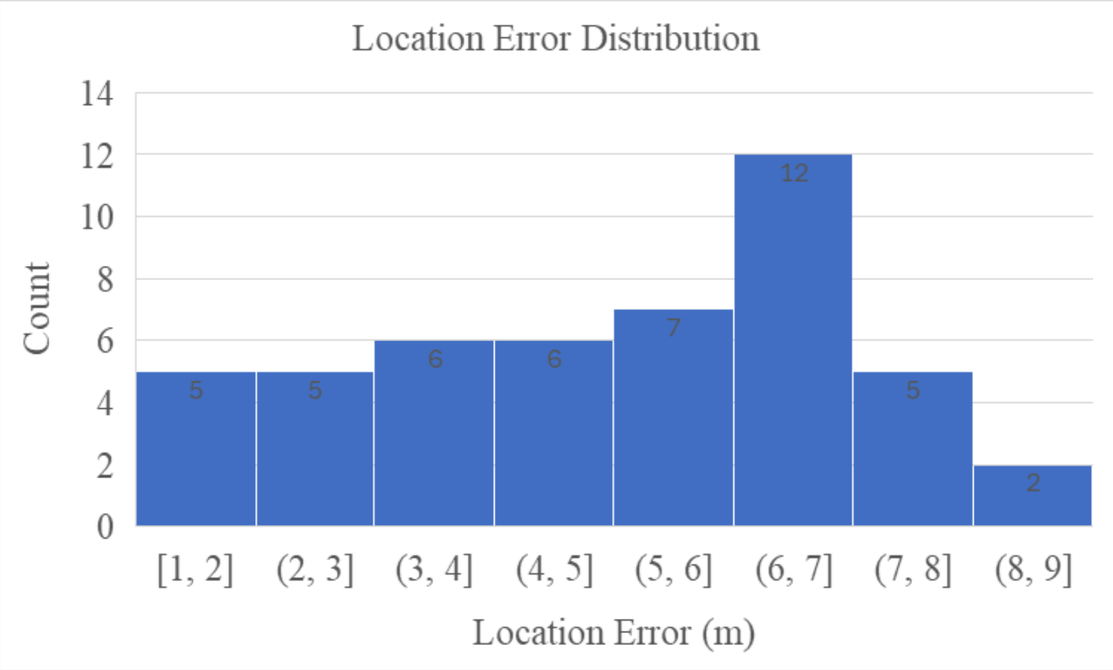
# Results Mapping



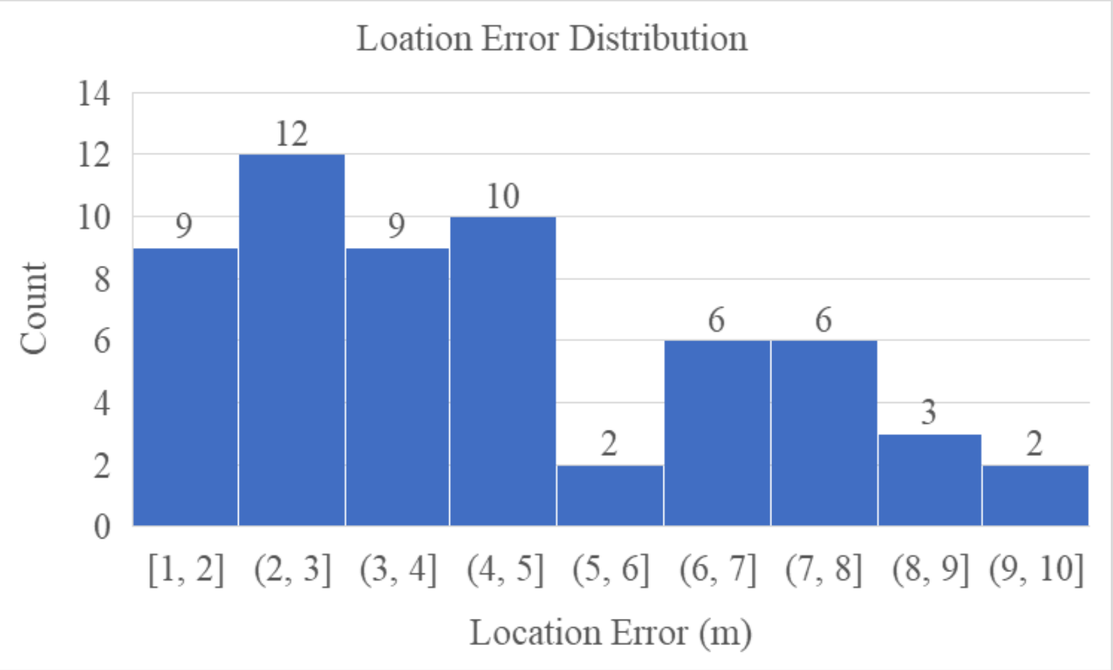
# Results Accuracy

| Case Study | Extent (km) | #Actual | #Detected | TP | FP | FN | Precision | Recall |
|---|---|---|---|---|---|---|---|---|
| 1(PR,Rural) | 30 | 50 | 50 | 48 | 2 | 1 | 0.96 | 0.98 |
| 2(NR,Sub-Urban) | 10 | 60 | 63 | 59 | 4 | 0 | 0.938 | 1 |

Object tracking detected results in the test area



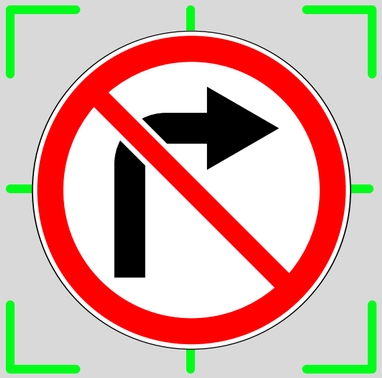

Case 1 with a mean error of 4.633 m




Case 2 with a mean error of 4.199 m

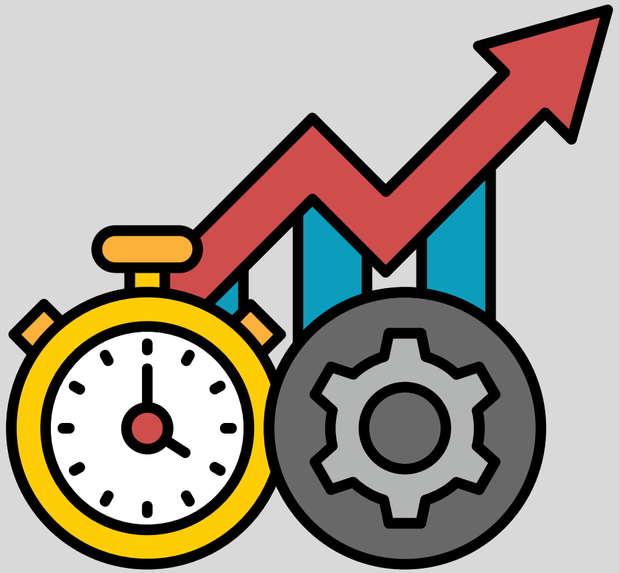
# False Detections

# Results Comparation

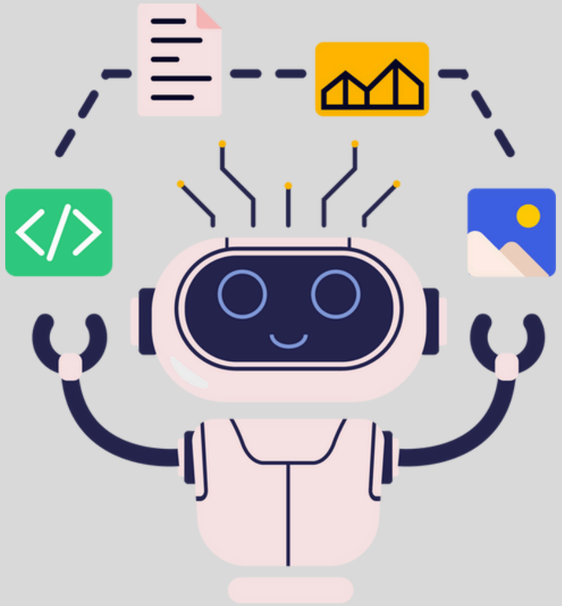


| Author | Method | Mean Average Error |
|---|---|---|
| Wilson et al. (2021) | GPS RetinaNet<br>on Mono Camera | 5.81m |
| Wang et al. (2010) | PCA, SVM<br>on Stereo Camera | 5-19m |
| Our | Object Detection & Triangulation<br>on Mono Camera | 4.63m |

# Conclusion



Budget-friendly, effortless and time-saving.



Up to date, portable and scalable

Save lives


RAMP
THANK YOU
FOR YOUR ATTENTION