CEN-300

Vehicle Trajectory Prediction using Aerial Images and Object Detection

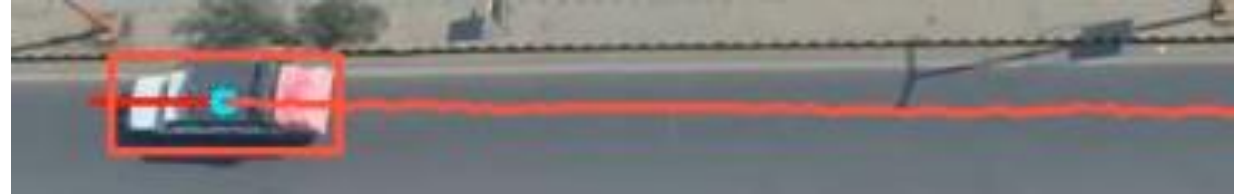Agam Pandey (22113009) | Hardik Chawla (22113056) |

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Tracking vehicle movements in real-time, mapping trajectories, predicting future trajectories, aiding in collision detection and prevention.
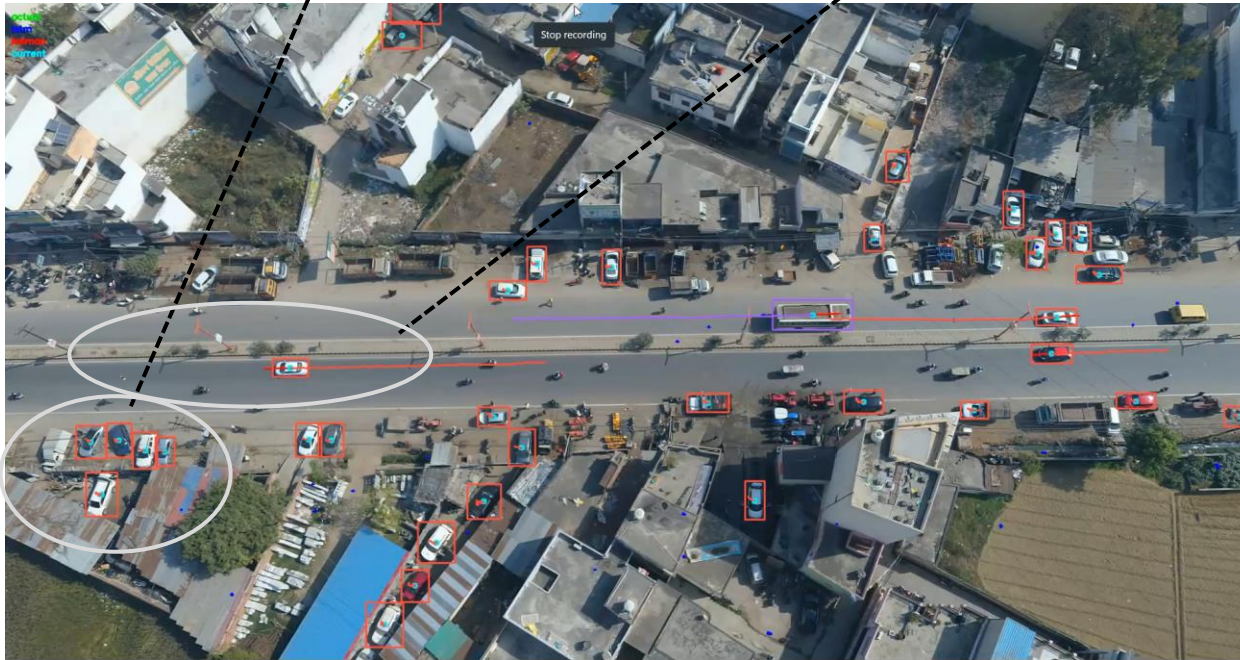
Object Detection

Predicted Trajectory Path

Past Trajectory

YOLOv8 for Object Detection : Frame wise vehicles are identified.

ByteTrack for Object Tracking : Unique-ID assigned to each detected vehicles and tracks their movement over time.

LSTM for Trajectory Prediction

Kalman Filter for Smoother Predictions : Noise reduction and path refinement.

Technical Implementation

1. DATA COLLECTION

2. OBJECT DETECTION : YOLOv8

- Model used : Pre-trained **YOLOv8 (Ultralytics)**
- Library : **supervision (Roboflow)** for processing detections
- Thresholds : Confidence = 0.3 ; IoU = 0.7
- Output : Bounding boxes for each vehicle

3. OBJECT TRACKING : ByteTrack

- Ensures consistent vehicle IDs across frames
- Storing vehicle movement data

4. DATA STORAGE

frame, timestamp, vehicle_id, x, y

timestamp	tracker_id	x	y
6.0217201709747314	1	232.09305	756.05334
6.151878833770752	1	232.13321	756.03406
6.259093523025513	1	232.23978	756.0377
6.385983706	1	232.20029	756.0022
6.473530054092407	1	232.15657	755.9508
6.566228866577148	1	232.29588	755.8724
6.661724805831909	1	232.37686	755.8384
6.756992340087891	1	232.38568	755.77795
6.844948053359985	1	232.38916	755.69977

...... 361474 records

5. TRAJECTORY PREDICTIONS

i. **Kalman Filter (Physics-based)**

- Handles noisy detections & smooths trajectory

ii. **LSTM (DL-based)**

- Predicts next **10 frames** for each vehicle

Scope for Improvement

1. **Fine-tuned** YOLO Model for Detection & Tracking : Improving accuracy in challenging conditions (night, foggy, etc.)

2. **More data** for LSTM training

3. Exploring SOTA **models** for trajectory prediction

4. Integrate Predicted Trajectories with **Driver Data**

THANKS