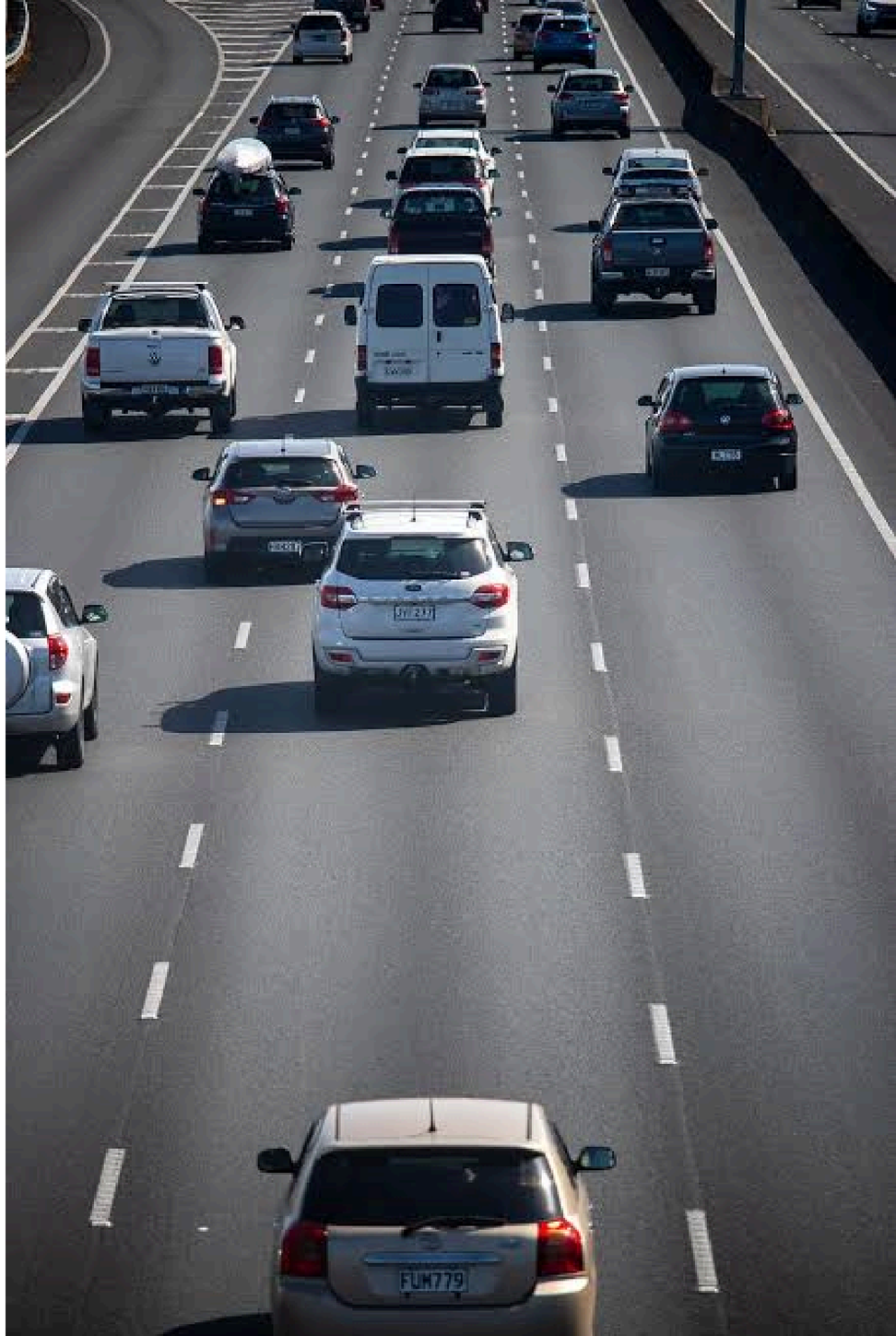
Comparitive Analysis of Heuristic Techniques for vehicles movement detection

- ***BTP CODE : B24SMP03***



Our Team

Mentor

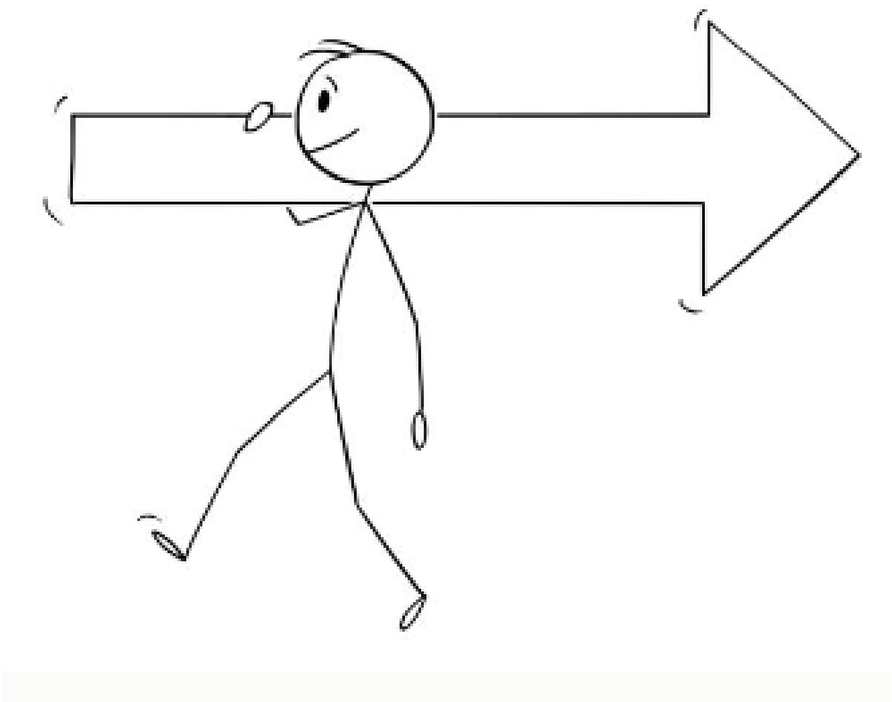
Dr. S Manipriya

Peddineni Rupesh chowdary	S.V.S.Apparao	Oothuru khadar basha
S20210010173	S20210010208	S20210010164

Introduction

Our thesis project is develop and compare algorithms which detect the boundaries of the region of vehicles movement in different directions

Recap



- Dataset collection
- Exploring ideas
- Literature Survey

What we are trying to do?

Highway video

Road Surface Segmentation

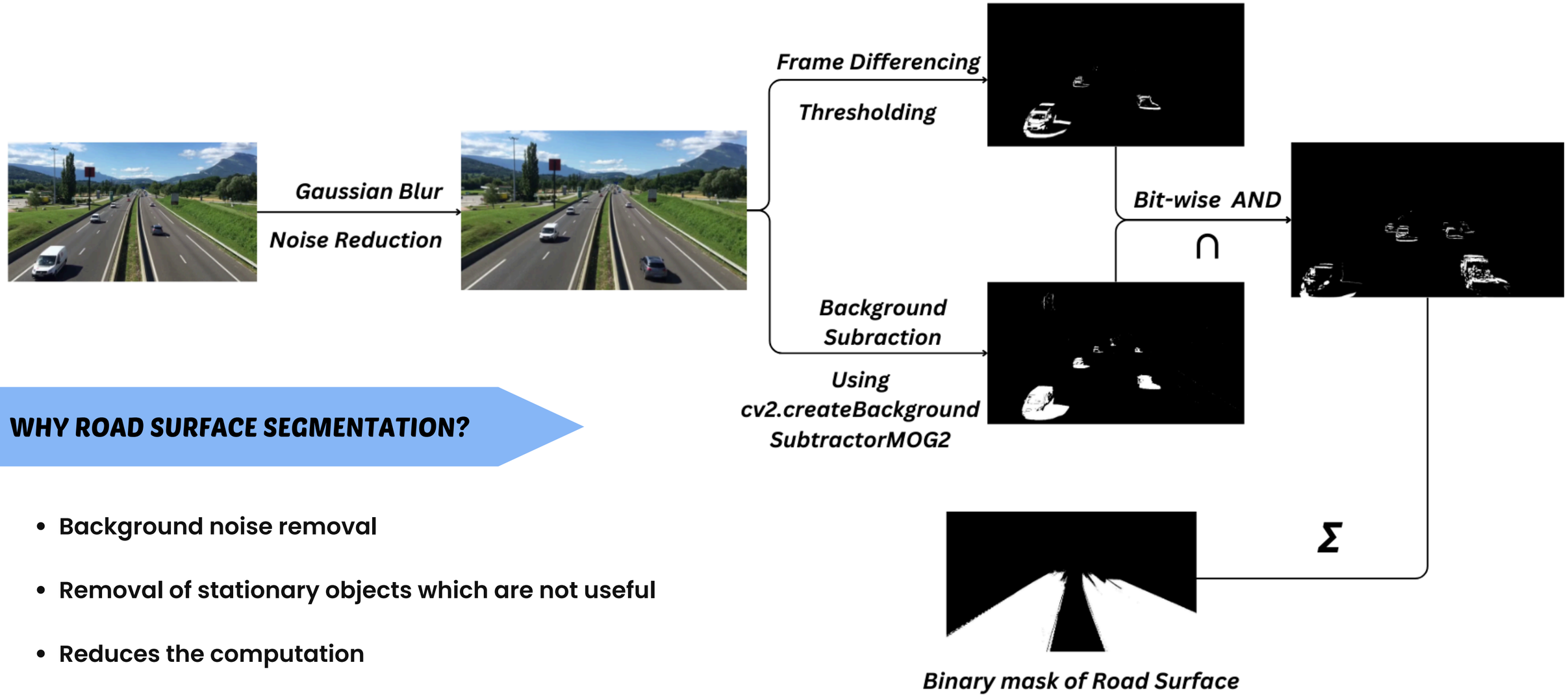
Different directions of motions detections

Boundary Detection

Comparision using different methods

Our Implementations and Idealogy

Road Surface Segmentation



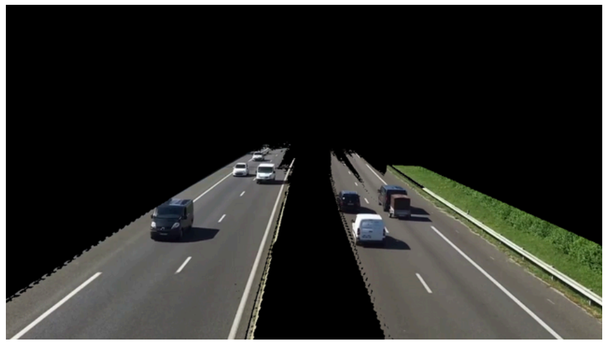
WHY ROAD SURFACE SEGMENTATION?

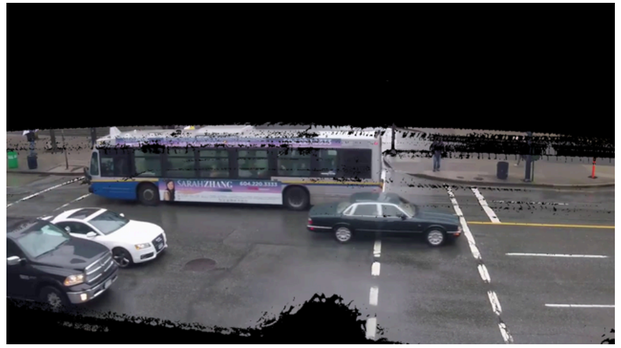
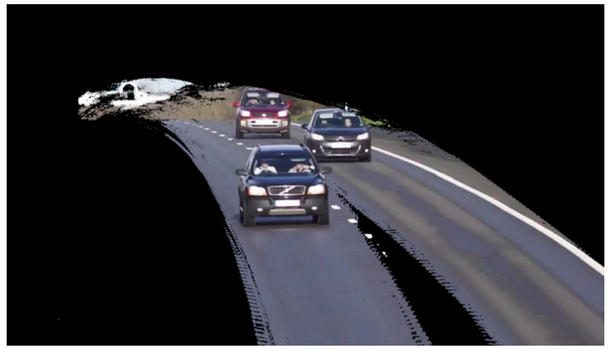
- Background noise removal
- Removal of stationary objects which are not useful
- Reduces the computation

Road Surface Segmentation on Various Videos on Benchmark Dataset







Approach -I

Boundary detection of different directions of motions using Lucas- Kanade Optical flow Algorithm

Algorithm :

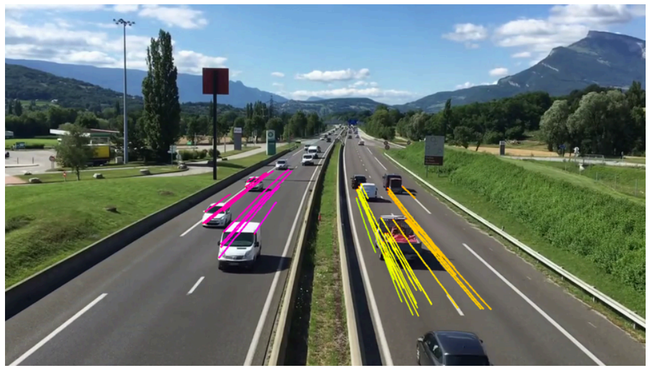
- Appling the road surface segmentation on 250 frames
- Optical flow is Useful for tracking objects in video footage
- We estimate the locations of keypoints in the current frame using previous frame
- The algorithm checks the consistency of these estimates
- Only the points with consistent estimates are added into trajectory
- The points which are at a consistent distance from previous feature point in the trajectory are only considered

Contd.

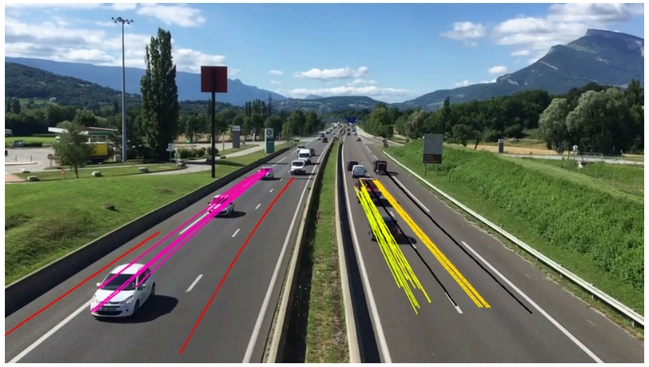
- Direction vectors of vehicles are estimated using last 2 points of trajectories
- Based on direction vectors we can decide the direction of vehicle
- Based on above, we get the boundaries in each direction
- cv2.goodFeaturesToTrack() returns the corner points which are considered to be good features for the next frame

Work Flow of Algorithm :

Road Surface segmentation



Optical flow trajectories



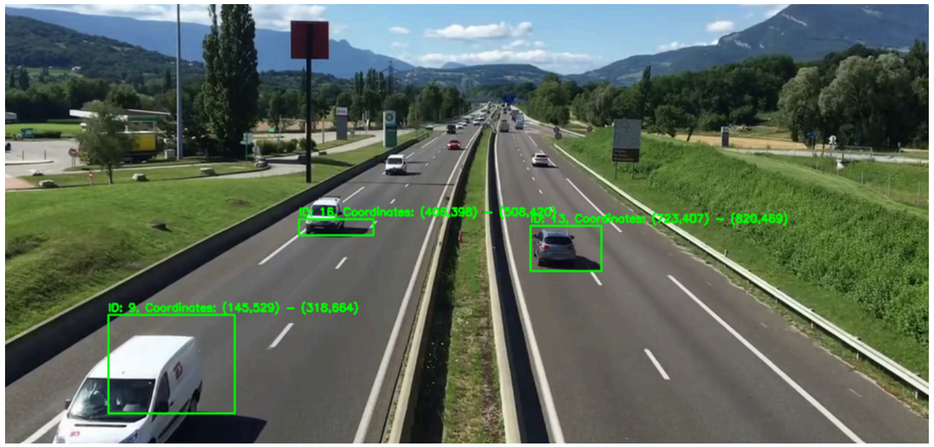
Output

Approach -II

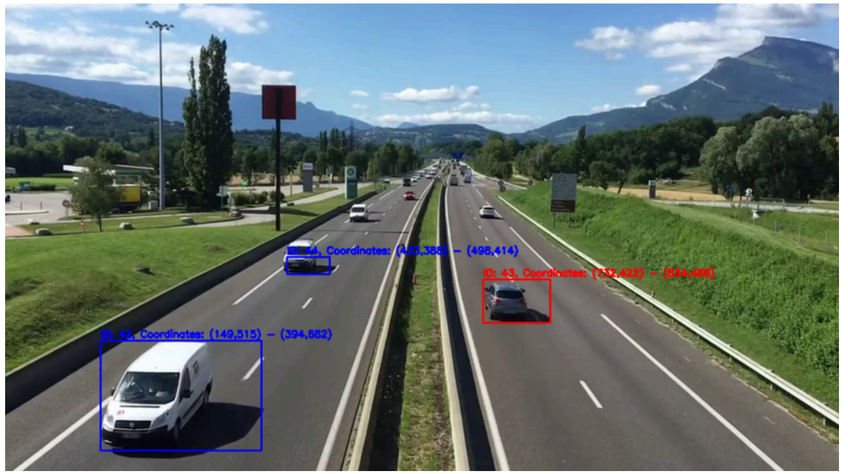
Boundary detection of different directions of motions using Blob Tracking and SORT

Algorithm :

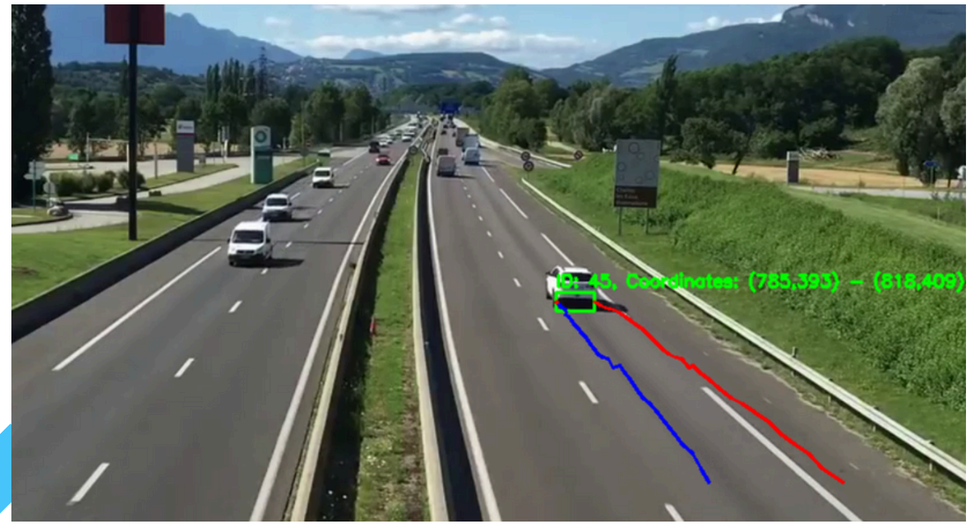
- **Initially we have to take first 250 frames of the video.**
- **Using Blob tracking we can detect and track the vehicle .**
- **By Using the SORT Algorithm we can find the multiple objects in a video sequence.**

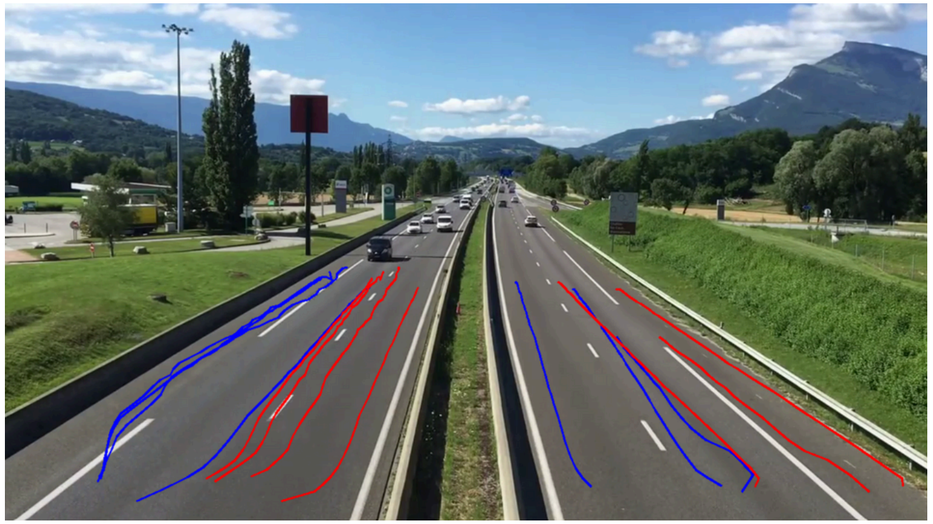


Contd.



- Based on the current position and previous position we can decide the direction of the vehicle .
- Assigning different colors to vehicles in each direction
- From vehicle tracker , by using co-ordinates of every vehicles we can draw the left and right trajectorys of the vehicle .



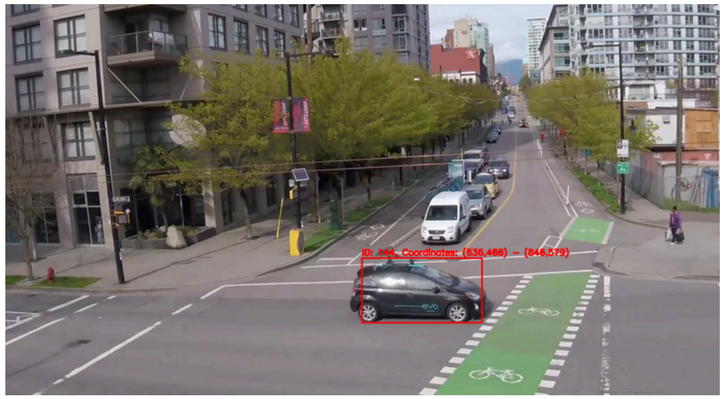


Road Boundaries Detection Example Using Blob Tracking Method

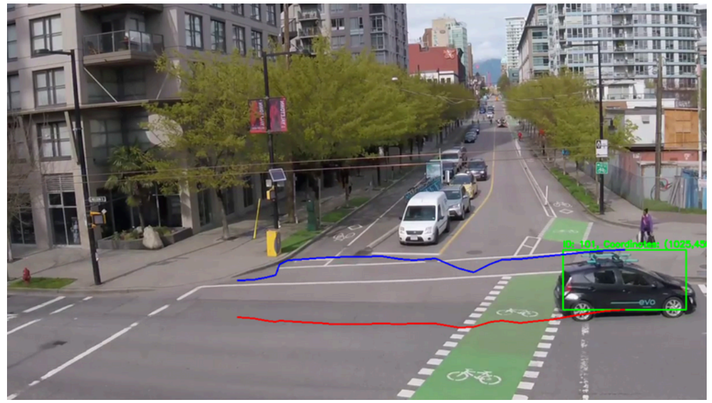
Normal Image

Image after background subtraction

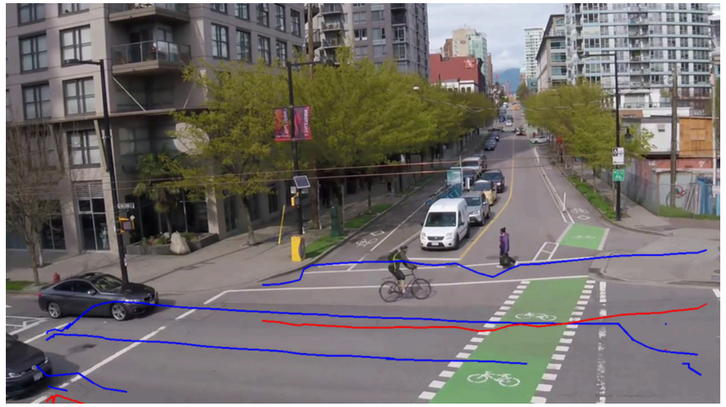
Blob tracking



Finding Directions



Trajectory of the car



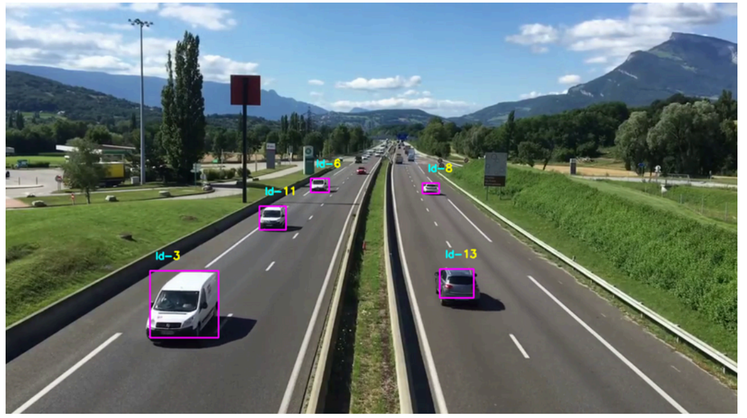
Trajectory of all cars in initial 250 frames

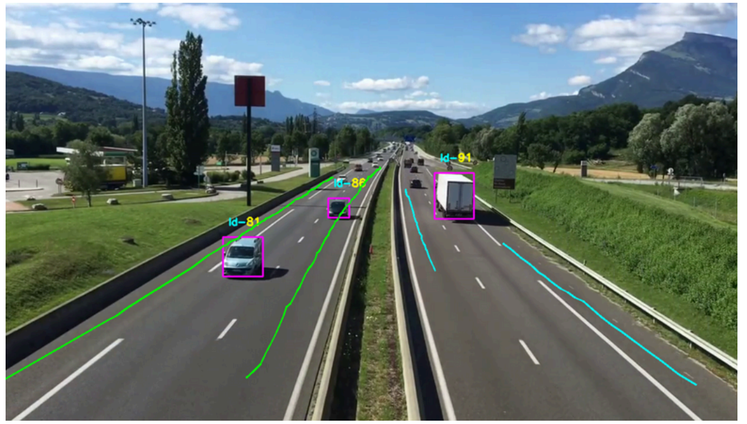
Approach -III

Boundary detection of different directions of motions using YOLO and SORT Algorithms

Algorithm :

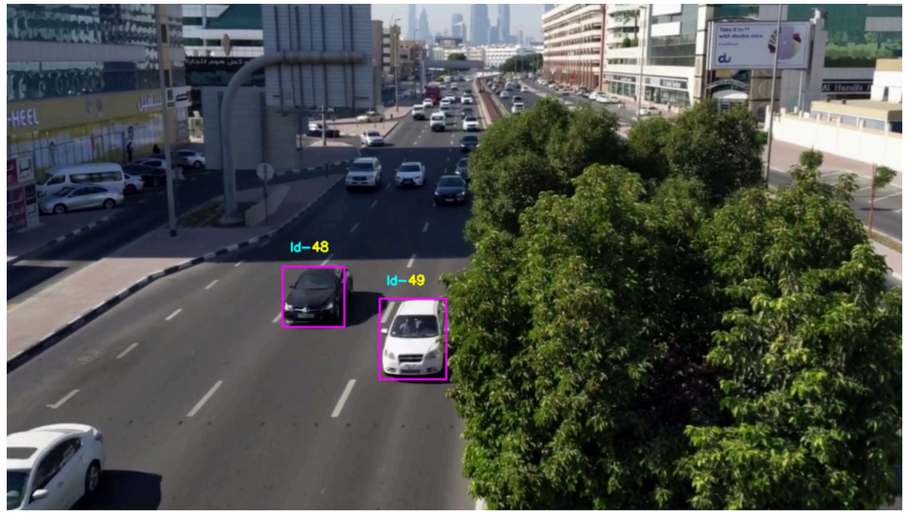
- Iterate through initial 250 frames
- Using YOLO to get the detections of vehicles moving
- Using the detections to track the vehicles using SORT Algorithm
- Considering the current position and previous position of each vehicle, to decide the direction of the vehicle
- Finding the tracking ID of the vehicles which represent the boundary in that direction

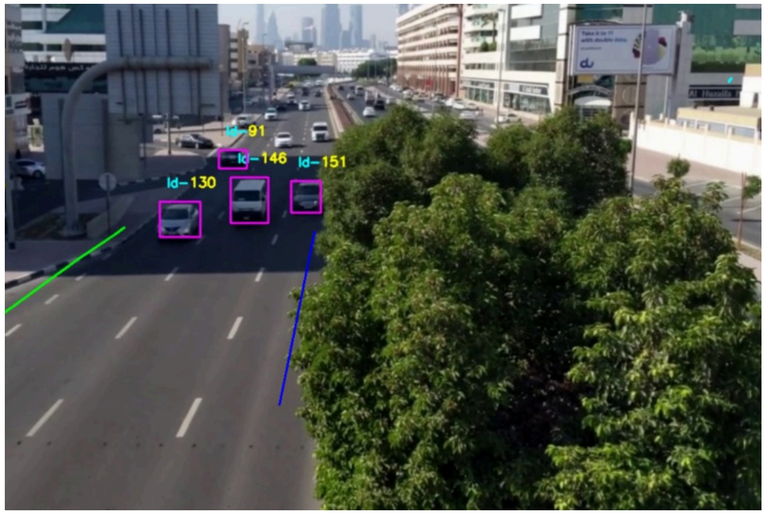




Contd.

- Considering the trajectory of that vehicle, gives the boundary in that direction
- Two cases, to confirm the vehicle is moving in that direction using x, y coordinates
- Vice-versa, used to detect boundary of that direction





Evaluation metrics

- Approaches we implemented are prediction tasks
- Considering Standard metrics for evaluating the performance.
- The error we are considering is Mean Square Error(MSE), Root Mean Square Error(RMSE)

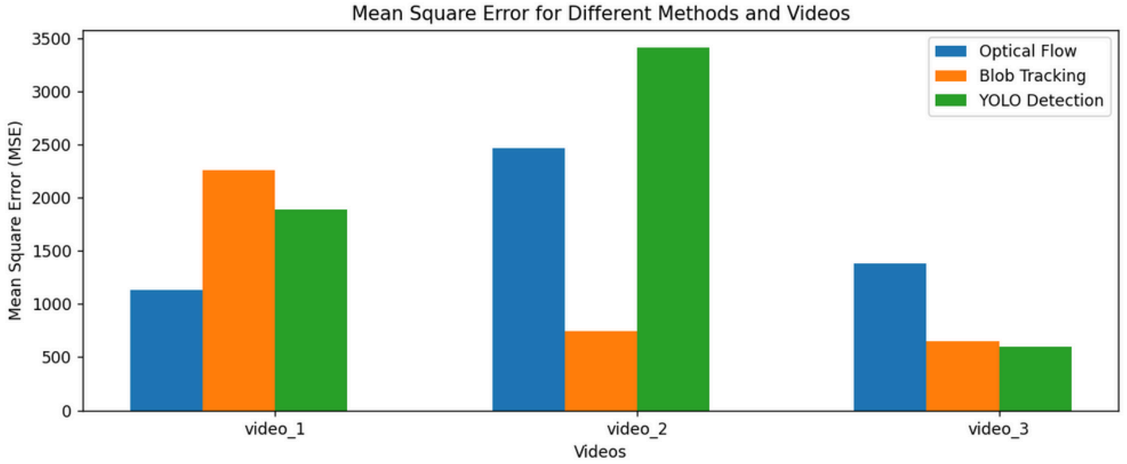
$$\mathrm{MSE} = \frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2$$

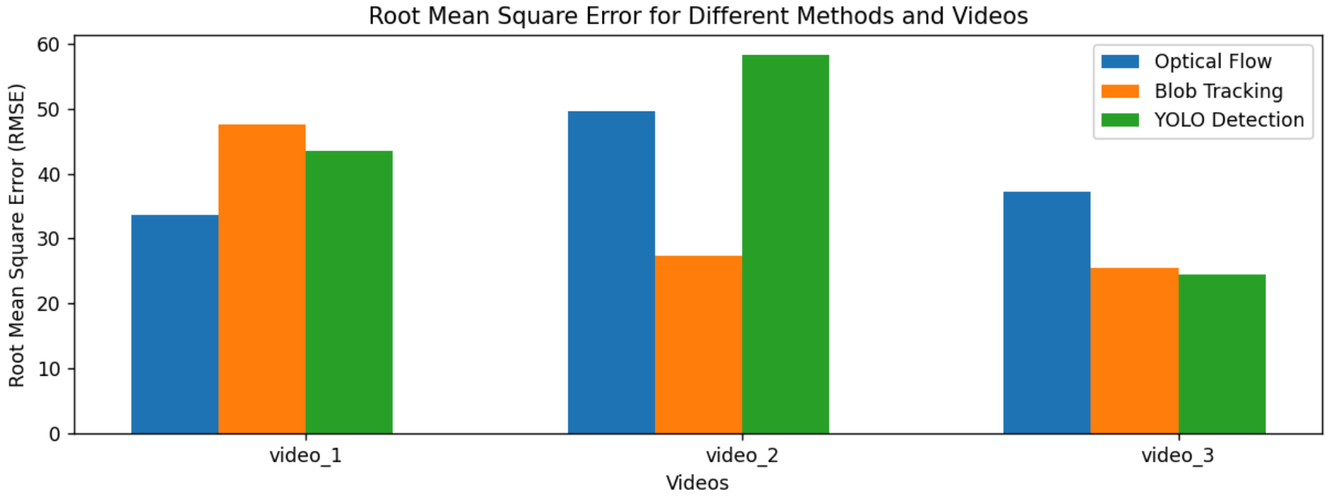
MSE = mean squared error
n = number of data points
Y_i = observed values
$\hat{Y}_i$ = predicted values

- We can also use few alternative approaches like Visual Inspection etc.

Comparison of results

Videos	Adaptive Optical FLow	Adaptive Blob Tracking	Adaptive YOLO and SORT
1.) 	MSE : 1384.38 RMSE : 37.21	MSE : 648.25 RMSE : 25.46	MSE : 594.75 RMSE : 24.39
2.) 	MSE : 2467.25 RMSE : 49.671	MSE : 742.5 RMSE : 27.25	MSE : 3407.75 RMSE : 58.36
3.) 	MSE : 1133.75 RMSE : 33.67	MSE : 2260.05 RMSE : 47.54	MSE : 1889.25 RMSE : 43.46



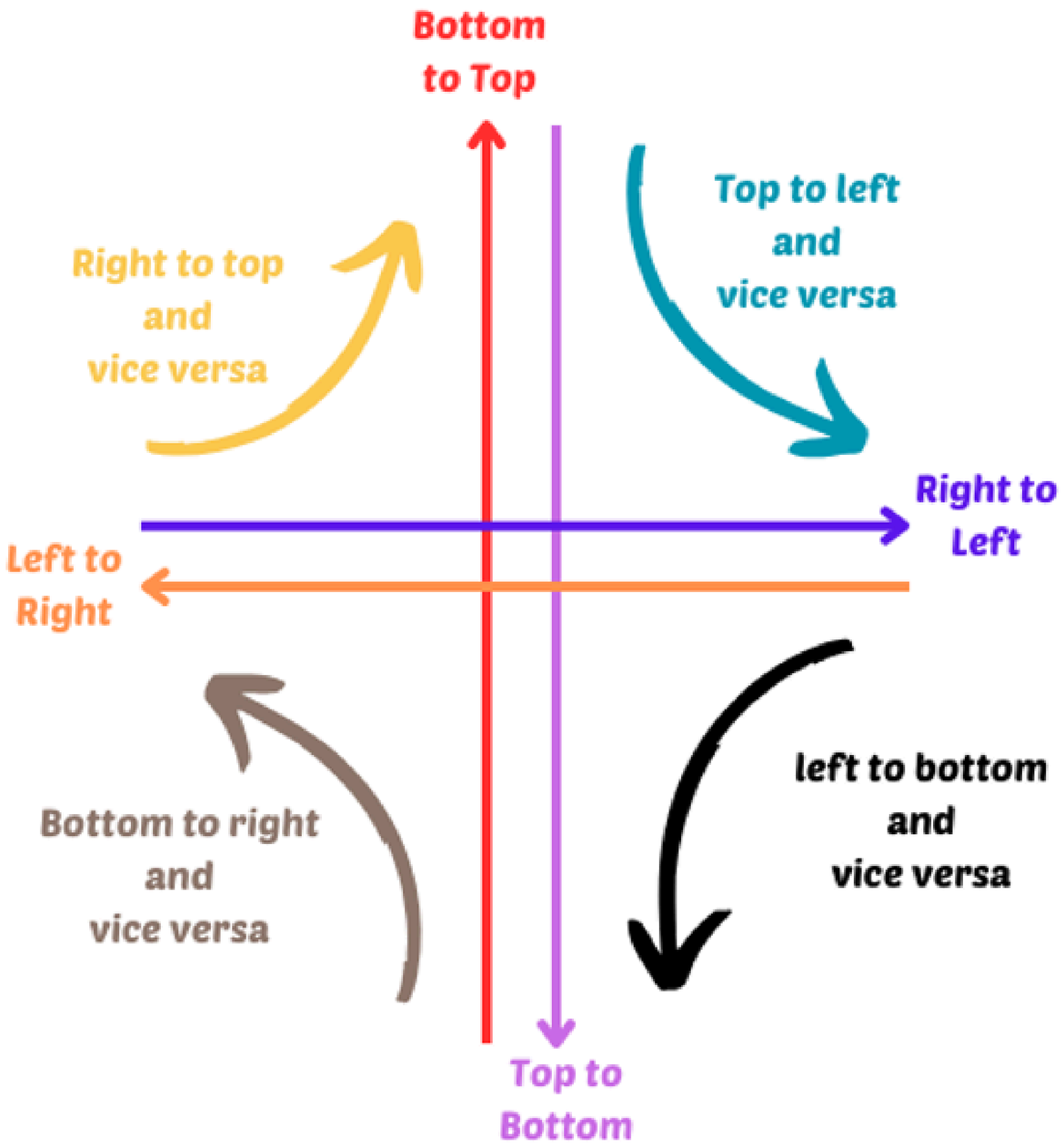


Averages of Mean Square Error

- **Optical flow : 1,673.7234**
- **Blob tracking : 1,221.734**
- **YOLO and SORT : 1,969.167**

Averages of Root Mean Square Error

- **Optical flow : 40.91**
- **Blob tracking : 34.953**
- **YOLO and SORT : 44.38**



Future Work

- Implemented for 4 directions
- Implement remaining directions of motions
- Implement dynamic thresholding

TimeLine

Review 1

Understand various research works, explore the dataset and conduct basic implementation

Review 2

Explore more research papers and implement different approaches of our problem statement

Review 3

Try to automate the thresholding and uncover areas for improvement.

Review 4

Try out the solution on detection technique and Document the research work

References

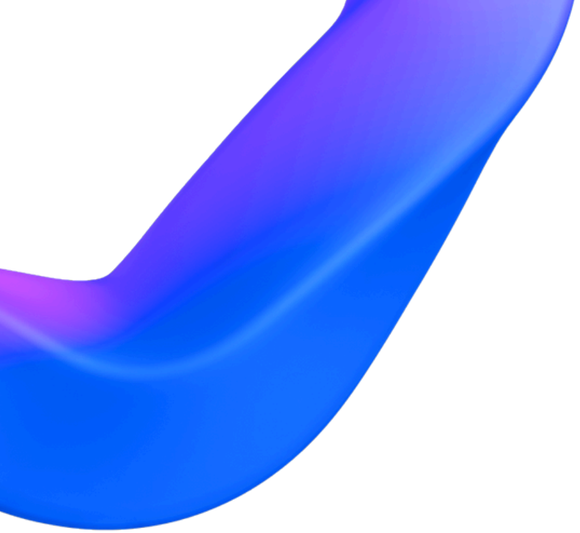
[1] Hadi Ghahremannezhad, Hang Shi, Chengjun Liu, “Automatic Road Detection in Traffic Videos”, IEEE 4th International Conference on Image Processing, Applications and Systems (IPAS) pp., 2021.

[2]https://media1.thehungryjpeg.com/thumbs2/ori_3747039_kin72ikv83zhz1j1fc74egtcs8m1fspdln7f9a9c_european-woman-comparing-a-with-b-vector-creative-idea-balancing-customer-review-compare-objects-purchases-ideas-strategies-isolated-flat-cartoon-illustration.jpg

[3]https://img.freepik.com/free-photo/urban-traffic-road-with-cityscape_1359-337.jpg?w=996&t=st=1714397533~exp=1714398133~hmac=a345002a2ae6fc886d7656be76f4a41460e6c4eedeb8c264951033d1e33fad75

[4]https://www.shutterstock.com/image-illustration/asphalt-highway-road-markings-background-260nw-108375362.jpg

[5]https://cdn.vectorstock.com/i/500p/59/83/cartoon-highway-empty-road-with-city-skyline-vector-28025983.jpg



Thank you