

Vehicle Counting using Drone Videos

Machine Vision, April 2019

N. Lakmal Deshapriya

Content

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1. Background

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Why Vehicle Counting

- Transportation System Planning,
- Examples:
 - Identify traffic volume in roads and make decisions to either expand road or design an alternative road.
 - Based on traffic volume in junction, allocate traffic light timing for each direction.

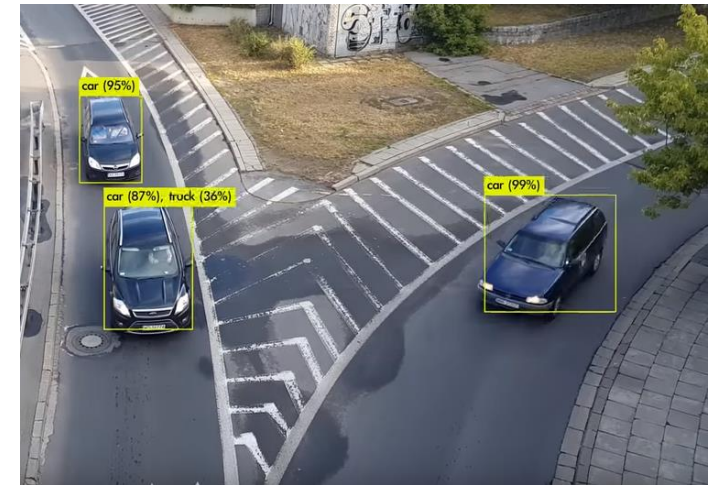
Methods to Count Vehicles



Manual Counting

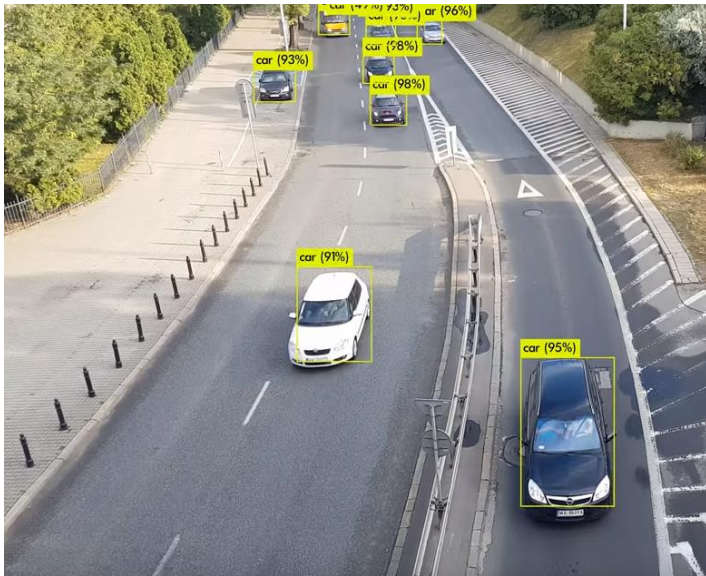


Electronic
Sensors

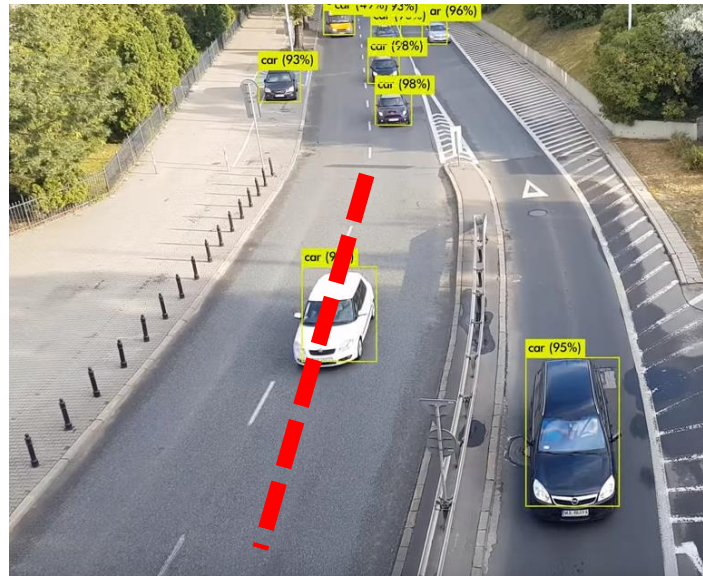


Cameras (Compute Vision)

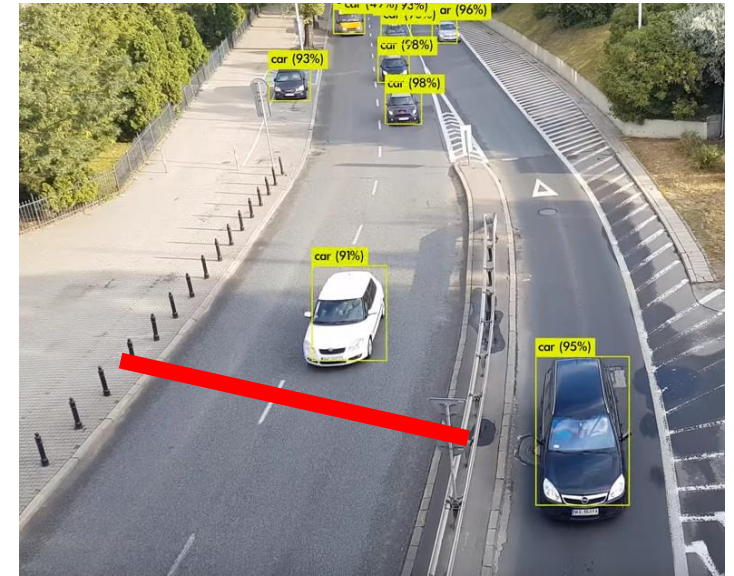
Computer Vision - Methods



1. Detection



2. Tracking



3. Counting through a Line

Only Pixels in Line is Required



- Frame Size – 1920 x 1080
- Frame Rate – 24 Frames per second
- Drone - DJI Phantom 3
- Duration - 30 seconds
- Altitude – 100 m

2. Method

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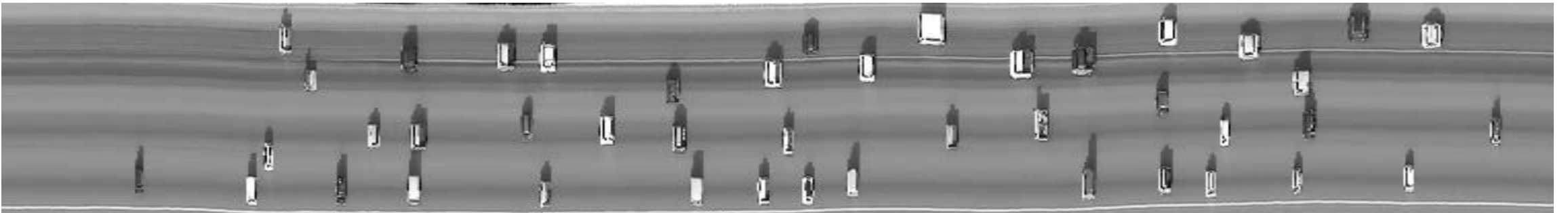
Stack the Lines



Frame # (Time Direction)



Convert to Gray Scale for Simplicity



Frame # (Time Direction)



Moving Medium in Time Direction To Get Background

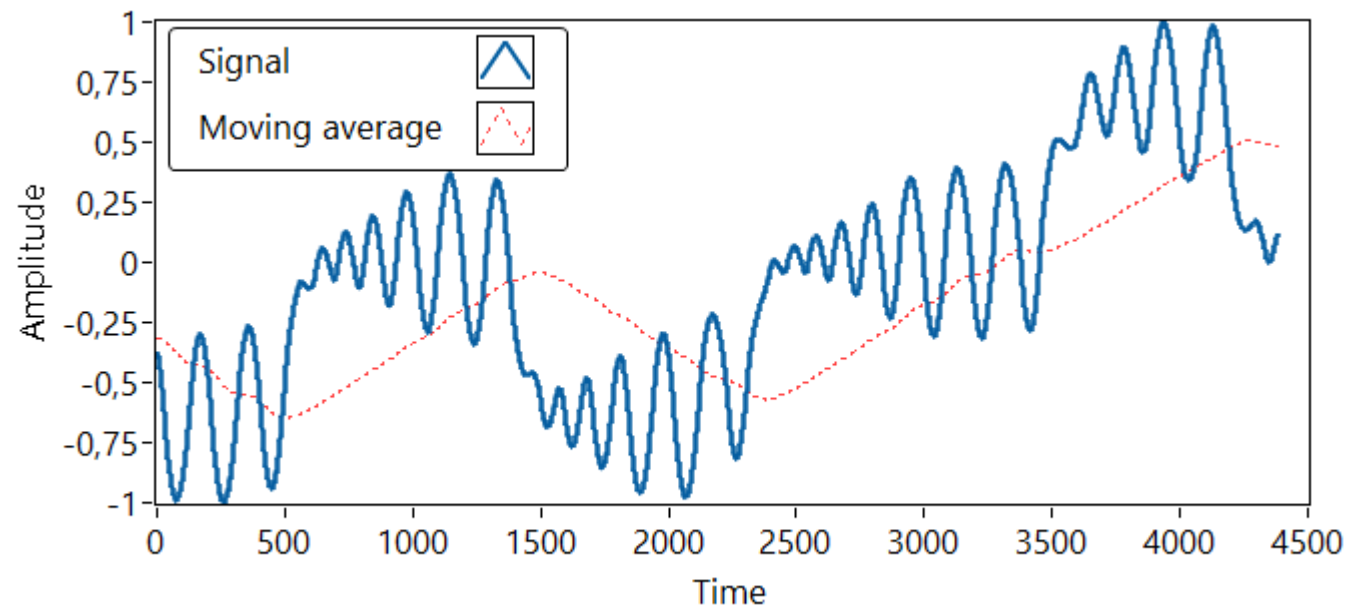


Frame # (Time Direction)

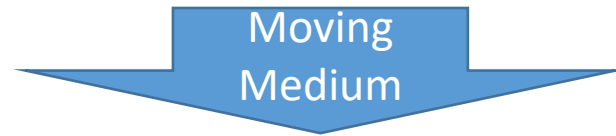
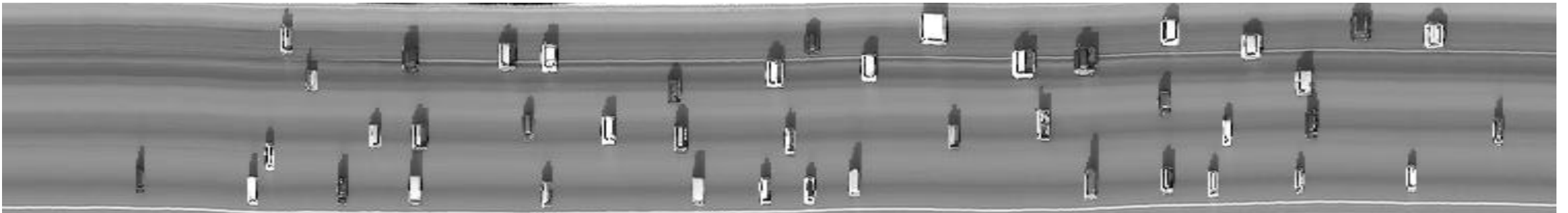
1. Select a Set of Lines (100 Lines) from Current Line and Calculate Medium in Time Direction
 2. Replace Current Line with Medium
 3. Likewise, move forward Line by Line in Time Direction
- Since probability of occurring background is higher than moving objection in a set of Lines , we can extract background

More in Moving Average / Medium As Smoothing Technique

- In our case, moving vehicles are noise. Smoothed version provide, moving vehicle free road (background)



Moving Medium in Time Direction To Get Background



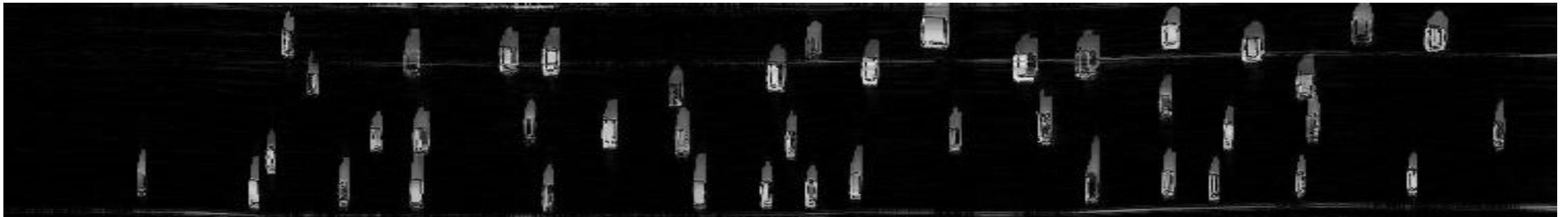
Remove Background to Get Moving Vehicles



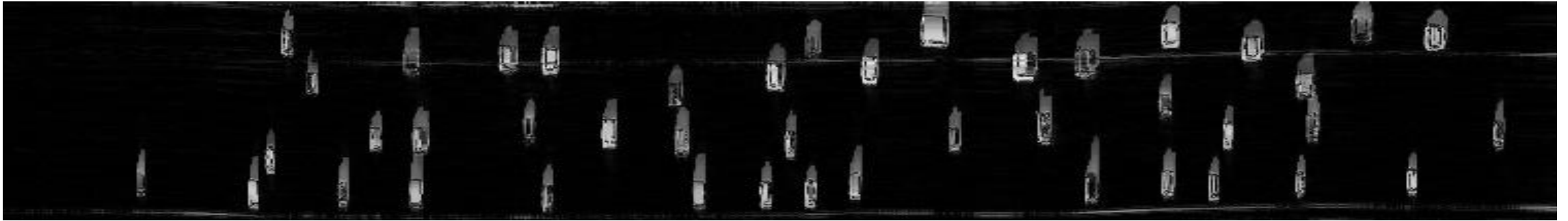
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Thresholding to Extract Moving Vehicles

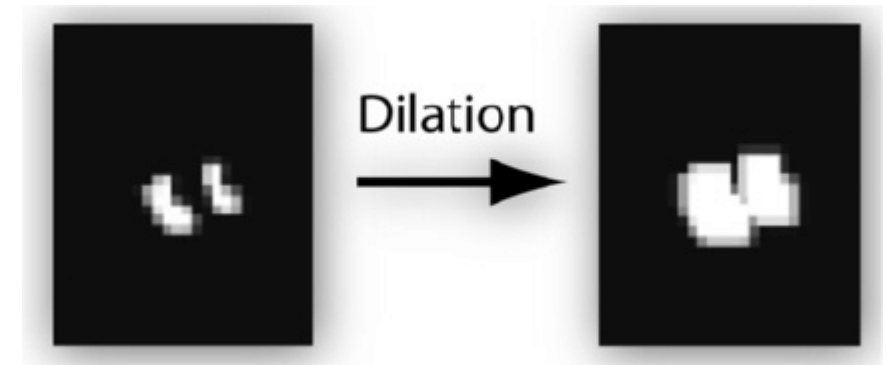
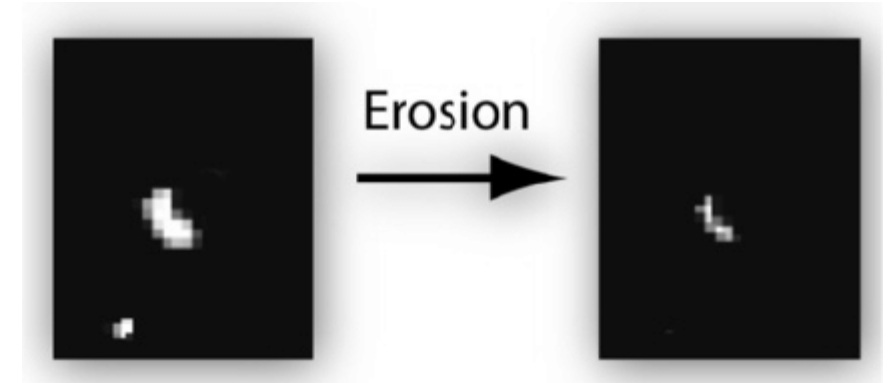


Apply
Empirical
Threshold

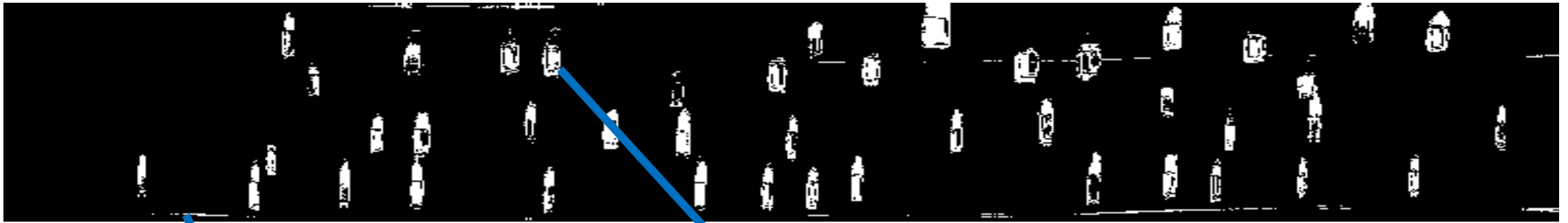


Morphological Processing for Cleaning

- Morphological Processing - Simply, good set of methods to deal with binary images
- Two fundamental operations –
 - Erosion – Smooth edges and remove small elements
 - Dilation – Connect near by disconnected elements



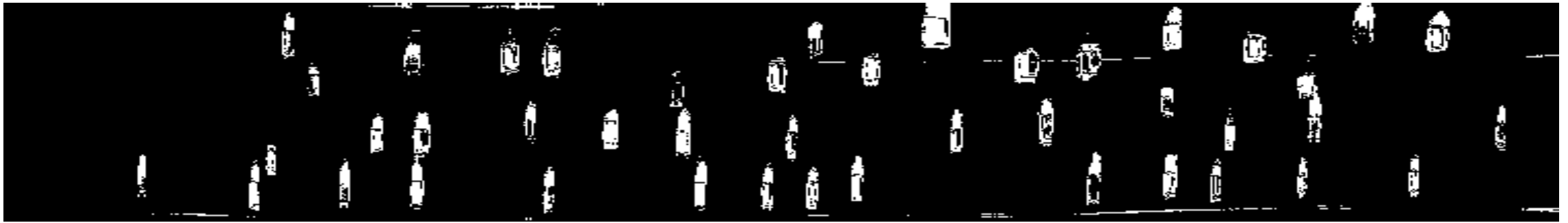
Errors



- Errors due to Drone movement (with fixed camera this will not be an issue)
- This can be fixed with erosion by a small circle

- Vehicle should be in square shape, missing parts in the middle
- This can be fixed by dilation by vertical and horizontal lines

Morphological Processing for Cleaning



1. Dilation with Vertical Line of Length 9
2. Erosion with Circle of Radius 2
3. Dilation with Horizontal Line of Length 9



3. Results

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Labelling and Counting



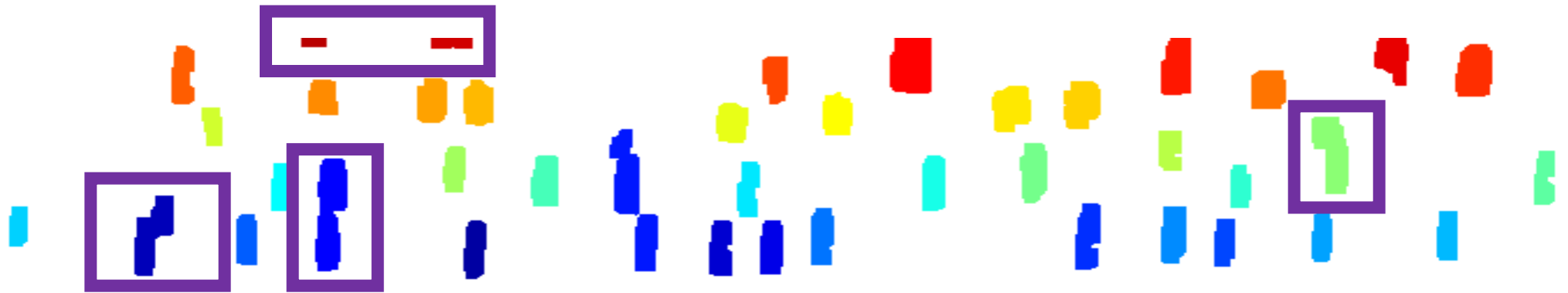
Labelling



Count

41 Vehicles Counted (Actual Number 44)

Failures



4. Summery and Conclusion

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Summery

1. Stack Line of Pixels in each frame
2. Use moving average to get background
3. Remove background and threshold to get moving vehicles
4. Use morphological processing to clean
5. Label and count moving vehicles in a video segment

Conclusion

- It's simple idea.
- Since it doesn't use whole image (use only pixels in a Line), it's faster.
- Can use fixed camera in ground platform instead of drone. That will eliminate errors due to drone movement.
- Thresholding and Morphological Operations can be replaced with ML method to find optimal parameters.

Thank you