ISP Final Project Report Ex1

Ex 1
Task 1

In Task 1, the objective was to detect and track moving vehicles on “Main Street.” A Region of Interest (ROI) was defined with global coordinates (left = 0, top = 250, width = 1040, height = 350) to focus the processing on the area where traffic is most relevant. To isolate moving objects, a background subtractor (MOG2) was initialized with a history of 500 frames, a variance threshold of 50, and shadow detection enabled. This configuration is for more effective extraction of the foreground mask even under varying lighting conditions.

Morphological operations (opening, closing, and dilation) were applied to the foreground mask to reduce noise and fill gaps, thus ensuring that the contours extracted from the mask are vehicles. Contours were then filtered based on their area (minimum 6000 and maximum 100000) and aspect ratio (0.25 to 4.0) to detect car-like shapes. The resulting detections were visualized by drawing bounding boxes around the moving vehicles. Processed frames were stored for later display, simulating a video playback.

Task 2

Task 2 was built upon Task 1 by adding a counting mechanism to determine the number of vehicles that travel from downtown to the city center. In this task, the same detection and tracking framework is used, but additional logic is implemented to count vehicles based on their movement across two vertical counting lines. A car is counted only if its track’s maximum x-coordinate was greater than a right-side threshold (RIGHT_THRESHOLD = 600) and its current centroid falls to the left of a left-side threshold (LEFT_THRESHOLD = 500). This two-threshold system is designed to ensure that only vehicles moving from right to left are counted, reflecting the typical flow from downtown to the city center.

A simple nearest-neighbor tracker is used to maintain a set of active tracks, where each track stores the current centroid, the maximum x-coordinate observed so far, and a flag indicating whether the car has been counted. Tracks that do not update for more than the configured number of frames (max_missed, set to 7) are removed, which helps prevent noise from affecting the count.

Analysis

The background subtraction approach, combined with contour filtering and morphological processing, allowed detection of vehicles. However, there were some challenges such as vehicles merging or tracks switching IDs, which is caused due to the tracking methods. The implemented counting mechanism, based on the two-line threshold, works well when vehicles are clearly separated and has a consistent tracking. In cases where vehicles overlap or occlusions occur, it does not work as well and further improvements, such as integrating more advanced tracking algorithms or appearance features, may be required.

Table for Task 2 :

	Total Number of Cars	Cars per minute
Traffic_Laramie_1	6	2.02
Traffic_Laramie_2	4	2.27