Vehicle Counting System Using Computer Vision

Project Report

Name: Piyush Vishwakarma
Course: B.Tech (AI & DS)

1. Introduction

Traffic monitoring plays a vital role in modern urban planning and smart city development. Manual vehicle counting methods are time-consuming and prone to errors. This project focuses on developing an automated vehicle counting system using computer vision techniques to detect and count vehicles from a video stream.

2. Objective of the Project

The main objective of this project is to automatically detect moving vehicles from a road video, track them using bounding boxes, and count each vehicle when it crosses a predefined line. The system also displays the count on the video output and prints updates in the terminal.

3. Technologies Used

• Python Programming Language
• OpenCV (cv2) for image and video processing
• NumPy for numerical operations
• Computer Vision techniques such as background subtraction and contour detection

4. System Architecture

The system processes a video input frame by frame. Each frame undergoes preprocessing such as grayscale conversion and blurring. Background subtraction is applied to isolate moving vehicles. Morphological operations clean the detected mask, followed by contour detection. Vehicles are tracked using bounding boxes and counted when their center crosses a defined line.

5. Background Subtraction Technique

The project uses the MOG2 background subtraction algorithm. This method learns the static background over time and highlights moving objects such as vehicles. It is effective for fixed-camera traffic videos.

6. Image Processing Steps

The input video frames are converted to grayscale to reduce complexity. Gaussian blur is applied to remove noise. Binary thresholding converts the image into black and white

format. Dilation and morphological closing operations are performed to remove small gaps and noise.

7. Vehicle Detection

Contours are extracted from the processed binary image. Small contours caused by noise are filtered using area and size thresholds. Bounding boxes are drawn around valid contours representing vehicles.

8. Vehicle Counting Logic

For each detected vehicle, the center point of the bounding box is calculated. A horizontal counting line is defined on the frame. When the center of a vehicle crosses this line, the vehicle count is incremented. Each event is displayed on the video and logged in the terminal.

9. Results and Output

The system successfully detects vehicles and draws bounding boxes around them. The total vehicle count is displayed on the video screen. Each vehicle crossing the line is also reported in the terminal in real time.

10. Advantages

- Automated vehicle counting
- Real-time processing
- Cost-effective solution
- Useful for traffic analysis and monitoring

11. Limitations

- Performance depends on lighting conditions
- Shadows may affect detection accuracy
- Best suited for fixed-camera videos

12. Conclusion

This project demonstrates an efficient vehicle detection and counting system using computer vision. It provides a practical and low-cost solution for traffic monitoring applications and can be further enhanced using advanced deep learning techniques.