Vehicle Counting and Classification Based on Digital Image Processing Algorithms

DIGITAL IMAGE PROCESSING - CS7.404.M24

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Abstract

This project explores the development of a vehicle counting and classification system using digital image processing techniques. By integrating object detection, edge detection, frame differentiation, and Kalman filtering, the proposed method aims to provide real-time traffic analysis with high accuracy.

1. Project Objective

The objective of this project is to design and implement a vehicle counter-classifier that accurately detects and classifies vehicles on highways using a combination of video-image processing methods. The system will assist in traffic management by providing reliable data on vehicle flow, enabling dynamic adjustments to traffic control systems.

2. Project Description

2.1 Problem Statement

The increasing number of vehicles on roadways demands efficient traffic management solutions. This project aims to develop a robust vehicle counting system using digital image processing techniques. The system will detect and classify vehicles in video streams, allowing for real-time traffic flow analysis and management.

2.2 Assumptions

- Traffic flow is unidirectional with no accidents or crashes.
- Vehicles adhere to legal and physical road limitations.
- The video data is captured from a top-down perspective to minimize occlusions.

2.3 Data Analysis and Preprocessing

We will use video feeds from highway cameras for data, ensuring scenarios involve unidirectional traffic with no accidents. Data will be sourced from highway cameras, Google live-streams, and similar platforms. To ensure the accuracy of the vehicle detection and classification process, the following preprocessing steps will be implemented:

1. **Grayscale Conversion:** The video feed will be converted to grayscale to reduce computational complexity, as color information is not critical for detection.
2. **Image Enhancement:** Gamma correction will be applied to enhance the contrast, improving the edge detection process.
3. **Edge Detection:** A Sobel filter will be used to detect edges, followed by thresholding to generate a binary image for background subtraction.
4. **Background Segmentation:** Background subtraction will isolate moving vehicles by removing static elements. A combination of forward and backward image differencing with the Sobel filter will be used.
5. **Kalman Filtering:** The Kalman filter will track vehicles across frames, reducing noise and improving the accuracy of the detection and classification process.

References

1. Tourani, A., & Shahbahrami, A. (2015). Vehicle counting method based on digital image processing algorithms. *2nd International Conference on Pattern Recognition and Image Analysis (IPRIA)*

2. Pancharatnam, M., & Sonnadara, U. (2008). Vehicle Counting and Classification from a Traffic Scene.

3. Jamiya S, S., & P., Esther. (2019). A Survey On Vehicle Detection And Tracking Algorithms In Real Time Video Surveillance.